Devoted to
TEXTILE
CHEMISTRY
BLEACHING
DYEING
PRINTING
FINISHING

MAY 17, 1948
VOLUME 37, No. 10

AMERICAN DYESTUFF REPORTER

OFFICIAL PUBLICATION
of the
PROCEEDINGS
AMERICAN ASSOCIATION
OF TEXTILE CHEMISTS
AND COLORISTS

Making Headlines
COLORFAST ANKLETS

anklets are probab

Vat-dyed cotton anklets are out of the "talking stage" and are reaching store counters in rapidly increasing volume . . . children's, women's, men's!

Anklets are probably laundered oftener than any other single item. This means that fast colors—VAT DYES—really are a "must." They answer the long-known need for anklets that can be laundered with the rest of the wash . . . anklets that won't bleed and ruin other articles . . . bright shades that will retain their color for the life of the merchandise.

Get the bright shades . . . and the deeper conservative shades . . . *with* color durability that only vats can give you in your line today. Our Technical Staff will be glad to assist you.
E. I. du Pont de Nemours & Co. (Inc.),
Dyestuffs Division,
Wilmington, 98, Del.

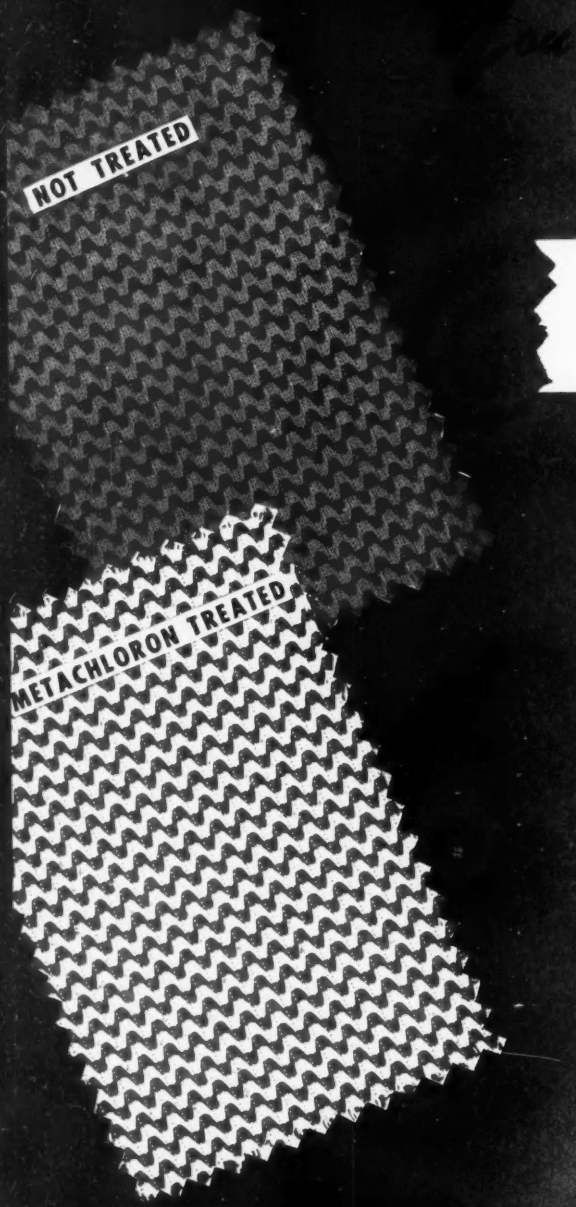
Du Pont Dyestuffs

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

You'll see a **BIG DIFFERENCE**

when you use . . .



METACHLORON

REG. U. S. PAT. OFFICE

Prevents MIGRATION OF COLORS!

Metachloron actually stops migration or bleeding of direct colors on cotton, rayon or wool. It eliminates lay and crease marks while the goods are going through subsequent operations after dyeing. Improves fastness to cold water, salt water, perspiration, hot pressing, wet and dry crocking.

Prevents COLOR DRAWING IN THE DRYER!

Streakiness and bronziness due to the color drawing in the dryer is eliminated by simply adding Metachloron to the last cold rinse. No effect upon the shade or finish. Metachloron is more effective in cold than hot water.

Prevents BLEEDING ON MIXED FIBERS!

Because METACHLORON stops bleeding from one fiber to another, clearer and brighter color effects are obtained on two tone or multicolor dyeings.

✓ **MODERATE COST**

✓ **SIMPLE APPLICATION**

IDEAL FOR TREATING ALL CLASSES OF PIECE GOODS, HOSIERY, KNIT GOODS OR YARNS.

BOOK WITH PRACTICAL DYED ILLUSTRATIONS AVAILABLE

The Althouse SERVICE LABORATORY *Assists You in Solving Your Dyeing Problems*

The House That Gives You DYE-FACTS REPORTS

ALTHOUSE

Chemical Company, Inc.

READING • PA.

AMANTHRENE* VAT COLORS
provide the answer to the demand for
better color fastness in textiles

YELLOW A2G

In double paste and
double powder form

A gay and full-toned yellow — particularly suited for printing on cotton and rayon where light, wash and chlorine fastness, as well as ease of production, are important factors.

May be dyed by the cold or warm vat methods, either as a self shade or in combination. Stock vatting is recommended.

Another of the Amanthrene range of superior vat colors. For detailed information on the whole range available, as well as data regarding your own particular requirements, consult our nearest branch. A.A.P. technicians are always happy to be of service.

AMERICAN ANILINE PRODUCTS, INC., 50 Union Square, New York, N. Y. • ***Plant:*** Lock Haven, Pa.
Branches: Boston, Mass. • Providence, R. I. • Philadelphia, Pa. • Charlotte, N. C. • Chicago, Ill. • Los Angeles, Cal.
Chattanooga, Tenn. • **Dominion Anilines & Chemicals Ltd.** • Toronto, Canada • Montreal, Canada

*Reg. U. S. Pat. Off.

OLATE COMPLETES THIS FULLING "TRIPLE PLAY" WITH PRECISION

Fast wetting out . . . excellent lubrication . . . thorough emulsification of oil and dirt . . . this triple-play fulling job is one which Olate handles with exceptional efficiency.

1 Wets Out Thoroughly and Quickly

Olate's extremely low titer assures fluid solutions which penetrate fibers quickly and evenly . . . eliminate dry spots . . . guard against uneven fulling and non-uniform felting.

2 Lubricates and Softens

Fluid Olate solutions soften the fabric quickly, too. No uneven lubrication to cause uneven shrinkage and poor coverage when Olate is on the job.

3 Emulsifies Oil and Dirt

Dirt and oil are loosened quickly and emulsified thoroughly when Olate goes to work. Dirt is held in suspension until it is ready to be flushed away during the scouring operation.

Olate can save you time, steam, and manpower in your fulling and scouring operations. Olate-processed woolens *look* better . . . *feel* better. Prove it with a month's trial.

Olate

Procter & Gamble

safe and efficient for every textile soap usage

American Dyestuff Reporter, Vol. 37, No. 10, May 17, 1948. Published every other Monday. Copyright, 1948, by Howes Publishing Co., Inc., One Madison Ave., New York 10, N. Y. Domestic subscription, $5.00; Canadian, $6.00; Foreign, $10.00. Entered as second-class matter, Nov. 6, 1919, at the New York, N. Y., Post Office, under the act of March 3, 1879.

INDANTHRENES
for cotton hosiery

cotton hosiery dyed with **INDANTHRENES**
are fast to • laundering chlorine
perspiration • crocking • light

GENERAL DYESTUFF CORPORATION
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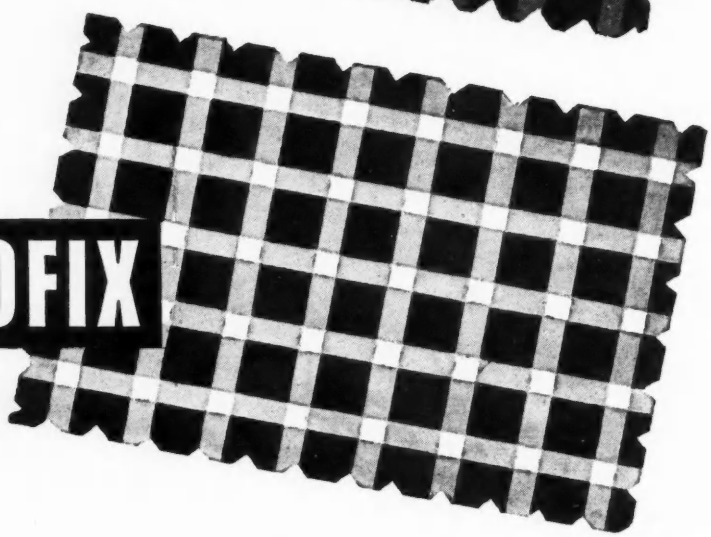
STOP

COLOR BLEEDING

with *CULOFIX



Preserve crisp detail and contrast of prints by using time-tested Culofix as an after treatment.

Kill bleeding troubles no matter where they occur—in the finishing bath—batching up after dyeing—in cross dyeing, etc.

Improve water fastness of direct colors and impart a very desirable soft, full finish at the same time, thus eliminating an extra finishing operation. (Where no softening action is needed, Culofix L should be used.)

If fastness to water or prevention of color migration is essential to your direct color dyeings, write for Technical Service Bulletin #204-106.1. Our technical staff is at your service without obligation.

*REG. U.S. PAT. OFF.

Arkansas Co. INC.

Manufacturers of Industrial Chemicals for Over 40 Years

NEWARK, NEW JERSEY

ATLANTIC PETROLEUM CHEMICALS

Ultrawet K's

New quality detergents in the form that's easiest, most economical for you.

You can get Atlantic's new K series Ultrawets in the form that best suits your processes—flakes, liquid or beads.

Superior wetting, sudsing and detergent properties make these improved alkyl aryl surface-active agents efficient and economical for cleaning compounds, cosmetics and industrial processes. They are immediately available in quantity.

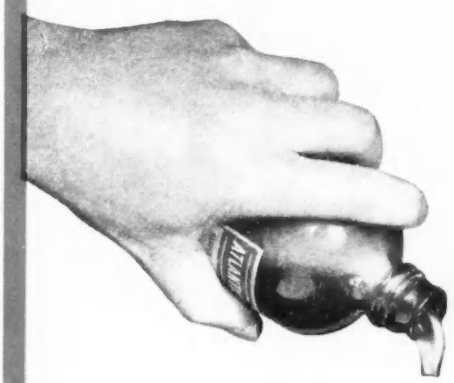
The efficiency of K series Ultrawets is greater in hard water. They save the trouble and expense of softening water.

As a liquid, Ultrawet K's are pale amber in color, and odorless (no kerosene or sludge odor). As flakes and beads, they approach the compounder's ideal of whiteness and lack of odor.

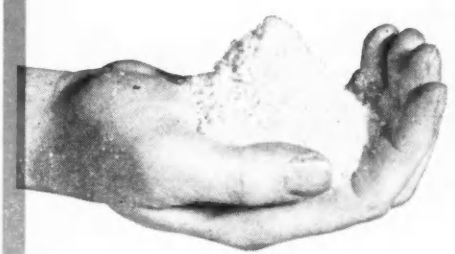
Ultrawet K's are the latest achievement of an organization that has produced quality detergents and wetting agents for over 10 years. Atlantic's great research facilities assure a product of uniform, high efficiency. The physical data:

	Ultrawet K Flakes	*Ultrawet 30K Liquid*	*Ultrawet SK Beads*
Wt. % Active Sulfonate—min.	**85**	**25.5**	**35**

LIQUID



FLAKES



BEADS

For samples, further information and quotations, write or wire

THE ATLANTIC REFINING COMPANY

CHEMICAL PRODUCTS DIVISION

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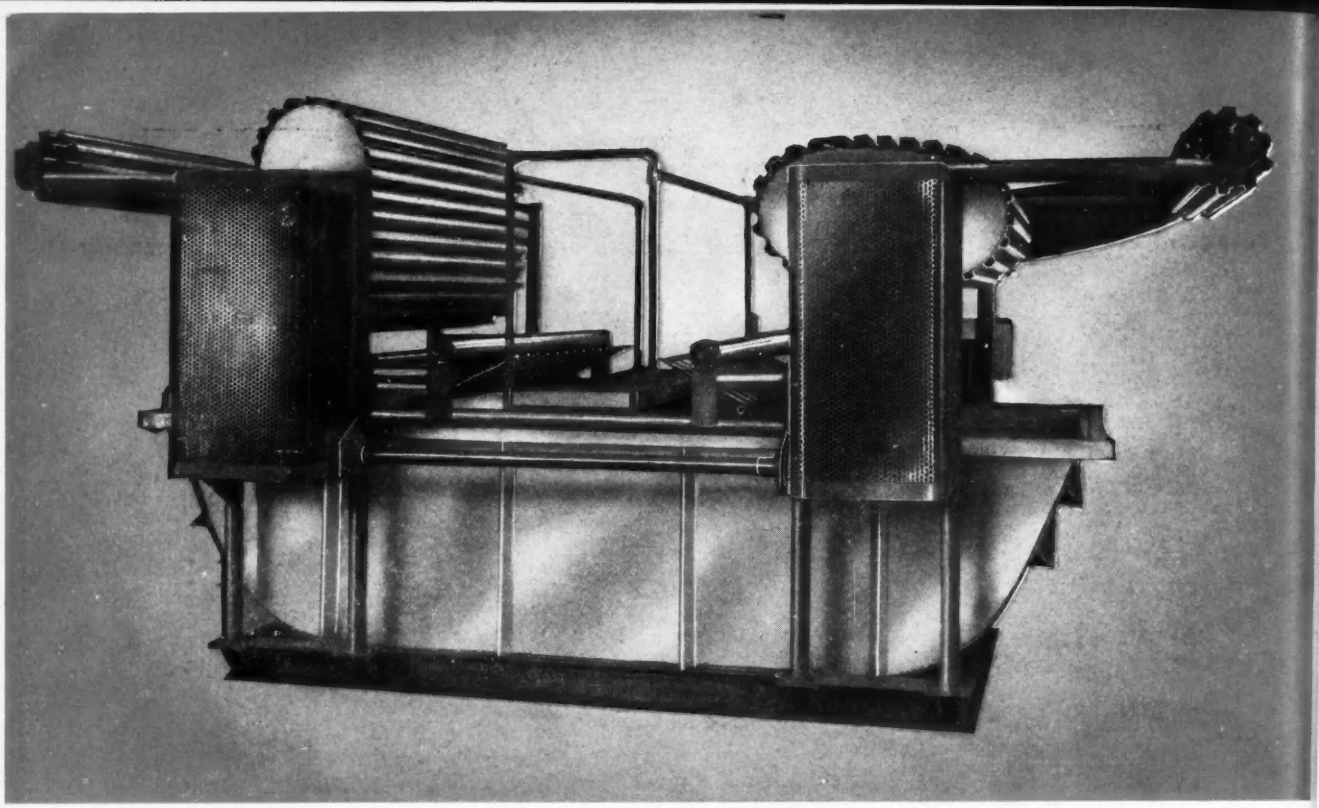
Chamber of Commerce Building, Pittsburgh, Pa.
Hospital Trust Building, Providence 1, R. I.



CONTINUOUS "DUPLEX" DYEING MACHINE

Usually improvements in Textile Machinery are slowly developed year by year, step by step—by alterations to machines that immediately precede the new. It is rare that really great improvements in performance are offered that make older machines uneconomic to operate.

This *is* such a machine. Its greater production makes one Duplex come close to replacing two single-line machines. Its continuity of controlled efficiency handles larger runs of yardage with the use of less dye liquor, only one of its economies. Now being used in a number of plants on a wide range of fabrics from lingerie sheers to suitings. It has an adaptability unmatched.

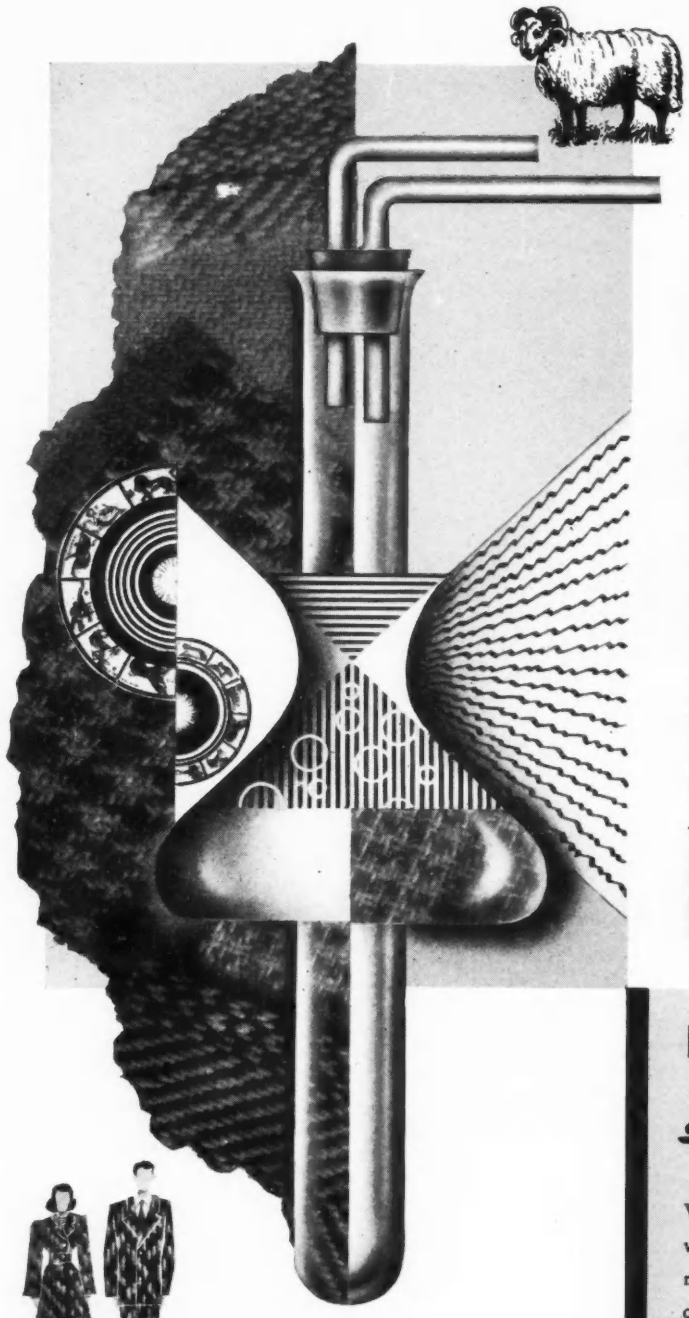
Due to the fact that this machine permits the dyeing of fabrics with very much less tension than older types of dye becks, it is now possible to dye continuously, fabrics which up to now have been handled only on single-line machines.

Write for further information

VAN VLAANDEREN MACHINE COMPANY

370 Straight Street, Paterson 3, New Jersey • Cable Address: Vlaanderen, Patersonnj, U.S.A.

World's largest manufacturer of machines for processing modern fabrics.



a new fabric is born

BUT...

How Will it Scour?

With a yard of your fabric in the grease we are in a position through our research laboratory to give you a complete detergency analysis. Join our many customers who are enjoying this service that offers you the most economical procedure for scouring your fabrics.

A Watson-Park representative will be glad to discuss your problems with you, or if you wish, just mail us the material you desire analyzed.

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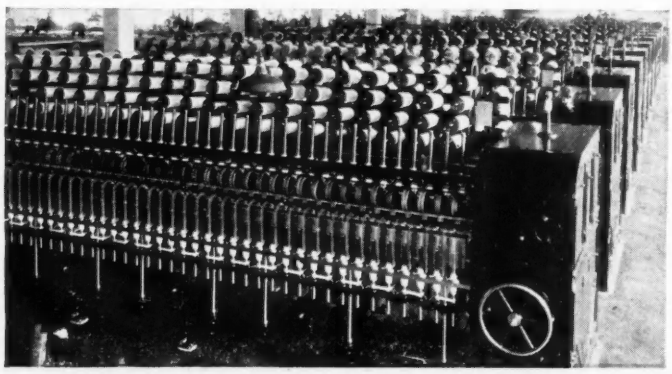
261 FRANKLIN ST. BOSTON, MASS.
FACTORY · LOWELL JUNCTION · MASS.

FOR YOUR INFORMATION



SYTON* GIVES 10% TO 30% INCREASED YARN STRENGTH IN WOOLS

Mill trials have proved that Syton is equally as effective as an aid to spinning on the woolen system as on the worsted.

Applied at the picker as an additive to the emulsion, a maximum of 3% to 3½% Syton solution has produced the following important advantages:

1.	Increased yarn strengths (10% to 30%)
2.	Loftier yarns
3.	Less twist
4.	Less ends-down
5.	Faster production rate

In addition, there are several benefits obtained in the carding operation. The application of Syton allows the production of much loftier roping which is much easier to draft in the subsequent spinning operation. The stock is packed down in the card to a lesser degree, resulting in a more uniform roping and therefore more uniform yarn. The roping is also much stronger with less ends-down, both at the condenser and in the unwinding of the jack-spools. Less rubbing is necessary at the aprons. Better dressing efficiency and better weaving efficiency have also been noted as a result of the increased strength.

For more information on Syton for wool spinning check E1 in the coupon at right. Monsanto technicians will be glad to superintend a mill trial of Syton on your own product under your own conditions. Add a note if you would be interested. **E1**

*Reg. U. S. Pat. Off.

STED USED FOR SOAPING RAYONS AND COTTONS

Recent tests show that Sted, Monsanto's powerful new industrial detergent, is a superior soaping-off agent for printed and dyed rayons and cottons. The new, non-sudsing textile cleanser removes and holds soil and excess coloring agents off the surface of fabrics and prevents redeposits on the fiber. *Low cost* Sted is strongly recommended for raw wool scouring and for back-washing, desizing, kier boiling and hosiery scouring. Check E-2 on the coupon for further information. **E2**

RESLOOM* FOR COTTON ADOPTED BY BANCROFT

Famous for its family of textile finishes, Joseph Bancroft & Sons is now using Monsanto's Resloom to enlarge its Everglaze line to include rayons as well as cottons and to produce subtle, low-lustre effects as well as crisp, glossy finishes. As Bancroft reports, these new effects "open a fresh world of fashions in spun rayons, cottons and mixtures... in fabrics satisfactorily stabilized." For information on Resloom C for crush-resistant cottons and rayons check E-3 and mail the coupon. **E3**

MERLON GIVES HERRINGBONE TWILL INCREASED ABRASION RESISTANCE

Tougher herringbone twill, for increased wear and tear, is possible with Merlon BR, Monsanto's vinyl butyral dispersion. For typical mill tests, samples of the fabric were treated with Merlon to deposit 6.3% resin solids on the weight of goods. The following improvement in abrasion resistance was noted:

Sample	Cycles to first hole
Control	2160
Treated	6790
Control 1 Wash	1500
Treated 1 Wash	4197
Control 3 Washes	1600
Treated 3 Washes	4146
Control 5 Washes	1536
Treated 5 Washes	4950
Control 10 Washes	1596
Treated 10 Washes	2791

Tests run on Tabor Abrader with #15 Wheel and 500 gram weight. Check E-4, on the coupon for further information. **E4**

REZGARD INSURES FLAME RESISTANCE

Flame tests prove that cellulosic fabrics will not support combustion or "afterglow" when treated with Monsanto's flame-retardant Rezgard. This product makes it possible and practical to treat textiles so that they will not glow more than one second after flame has been removed. Practical, easy-to-apply and low-cost, Rezgard makes no appreciable change in the appearance or "hand" of the fabric. For further information, check E-5 on the coupon. **E5**

RESLOOM BUILDS BETTER WOOLENS, WORSTEDS

The sales advantages of having your wools washable are many—but there's a good production reason for making them washable *with Resloom*. The Resloom treatment is an *additive* process—*it actually builds up the fabric*. In these days of high prices for wool stock and top, remember that Resloom *adds weight* and fullness to the cloth.

Resloomed wool merchandise has been selling successfully for more than a year. On literally hundreds of constructions Monsanto has convincing data that shows how effectively Resloom controls the shrinkage of woolens and worsteds. Check E-6 on the coupon below for more information on how Resloom can help you build better fabrics. **E6**

MONSANTO
CHEMICALS — PLASTICS

MONSANTO CHEMICAL COMPANY, TEXTILE CHEMICALS DEPT.
DESK ADT 5, 140 FEDERAL ST., BOSTON 10, MASS.

Please send information on

E1 E2 E3 E4 E5 E6

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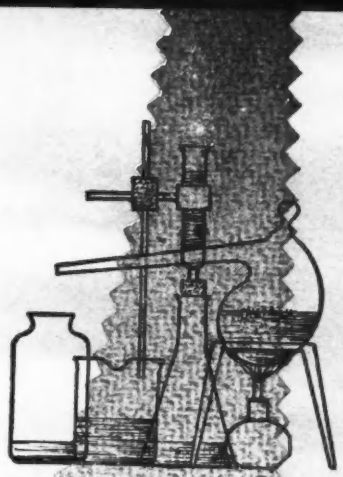

a NEW development applicable to all fabrics

REPCOLENE K-50

REPCOLENE K-50 has a wide field of application as a penetrating—scouring—wetting—leveling, dispersing and finishing agent

STABLE IN HARD WATER — COMPATIBLE WITH SOAP

REPCOLENE K-50 has good solubility action on animal and vegetable oils.

REPCOLENE K-50 is recommended as a greatly reduced [illegible] of following [illegible] and finishing operations.

[illegible] and write for [illegible]

REFINED PRODUCTS CORPORATION

Sunday-best in Stocking Fabrics

For the quiet dignity of a Church or the thrill of a first-night, stockings must always appear fresh and new. That's why hosiery buyers prefer stocking fabrics finished with Filaseal Resin Finishes. Filaseal causes stockings to return to their original shape despite repeated handling. In production too, Filaseal gives stockings the added body and snag resistance required for high speed operations. For stocking fabrics that look better, sell faster, find out about this outstanding Amalgamated finish today.

AMALGAMATED CHEMICAL CORP.
Phila. 34, Pa. : : Southern Div.: R. A. Bruce, *V. P. & Mgr.*, P.O. Box 35, Greensboro, N. C.

Filaseal

—to cut down snags and pulls

Stockings that look "handled" stay on the hosiery counter until all the "fresh" Stockings are sold.

Stockings finished with Filaseal sell faster because they look better . . . stay smooth and fresh.

The products of Amalgamated Chemical Corporation include Hosiery Finishes, Wetting Agents, Penetrants, Softeners, Detergents, Soaps, Water Repellent Finishes.

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. . . when QUADRAFOS* cuts costs

You use 25% to 50% less soap . . . less alkali . . . less bleach . . . less rinsing water . . . less time for cleaning equipment, when QUADRAFOS teams up with your process water. That's because QUADRAFOS ties up *all* the metals in water. Prevents them from reacting with soap to cause formation of insoluble precipitates that impair detergency, dull fabrics and foul up equipment.

Send for all the facts about the many ways QUADRAFOS can help you add profits to textile wet processing.

softens water without precipitation...deflocculates ...redissolves precipitates...promotes free rinsing

ONLY WITH
QUADRAFOS
CAN WATER
DO SO MUCH, SO WELL

*U. S. Reg. Trade-Mark for Sodium Tetraphosphate made by Rumford

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Technical Service Department
20 Newman Avenue
Rumford 16, Rhode Island

Please send me further information about the use of QUADRAFOS in textile wet processing. I'm particularly interested in:

- ☐ Raw wool scouring
- ☐ Piece goods scouring
- ☐ Kier boiling
- ☐ Reducing bleach requirements
- ☐ Brighter, more uniform dyeing
- ☐ Viscosity control of printing pastes
- ☐ .....

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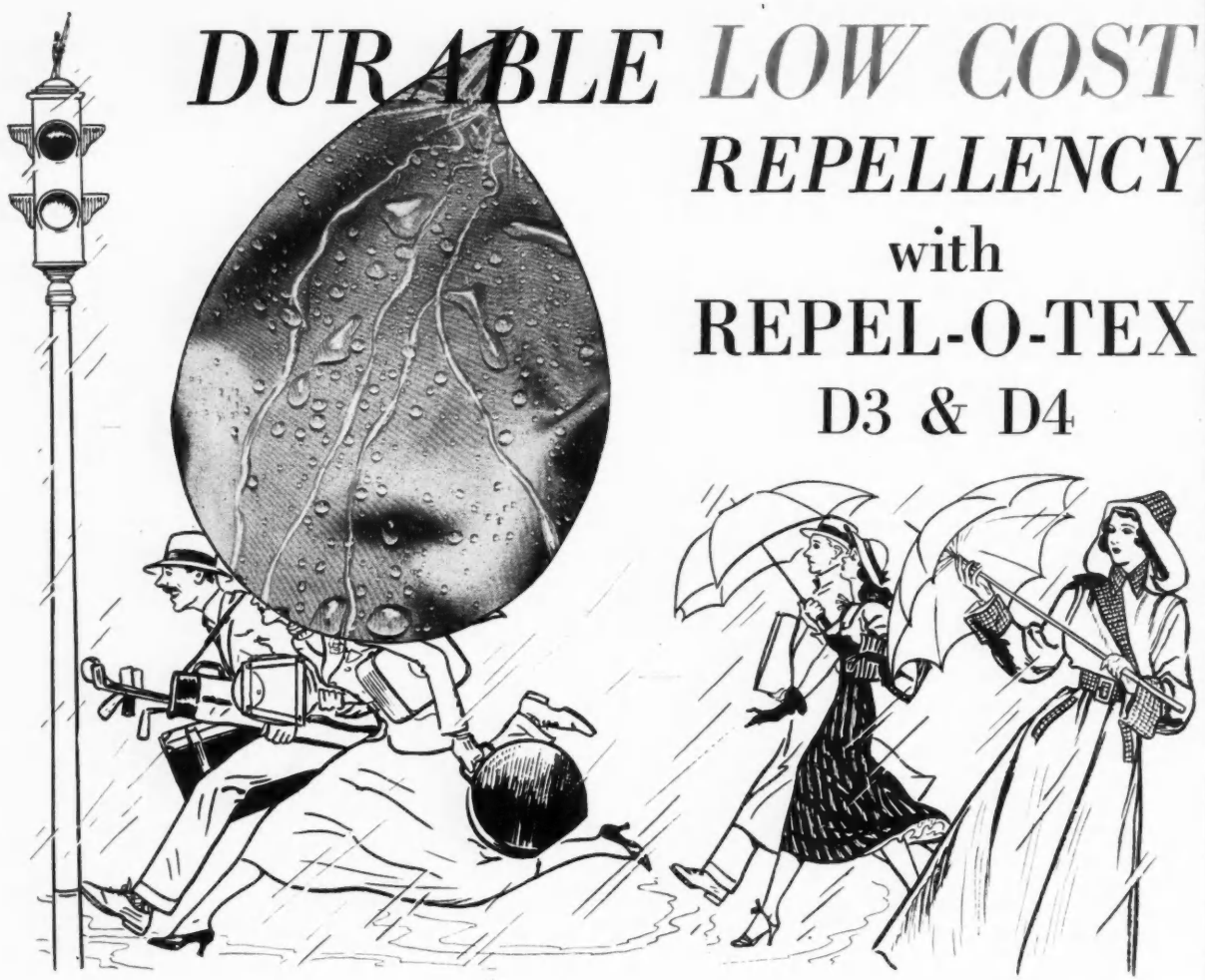
DURABLE LOW COST REPELLENCY with REPEL-O-TEX D3 & D4



ONYX REPEL-O-TEX D3 and D4 are two complementary materials, used in combination to provide low cost, exceptionally durable water repellency on cotton-rayon, cotton-acetate and many all-rayon, acetate and nylon constructions.

If you want effectively durable water repellency at the cost of ordinary repellent finishes, investigate these materials. Easy to apply in the jig, pad or quetsch, with no scouring or curing involved.

Ask for samples for a trial run!

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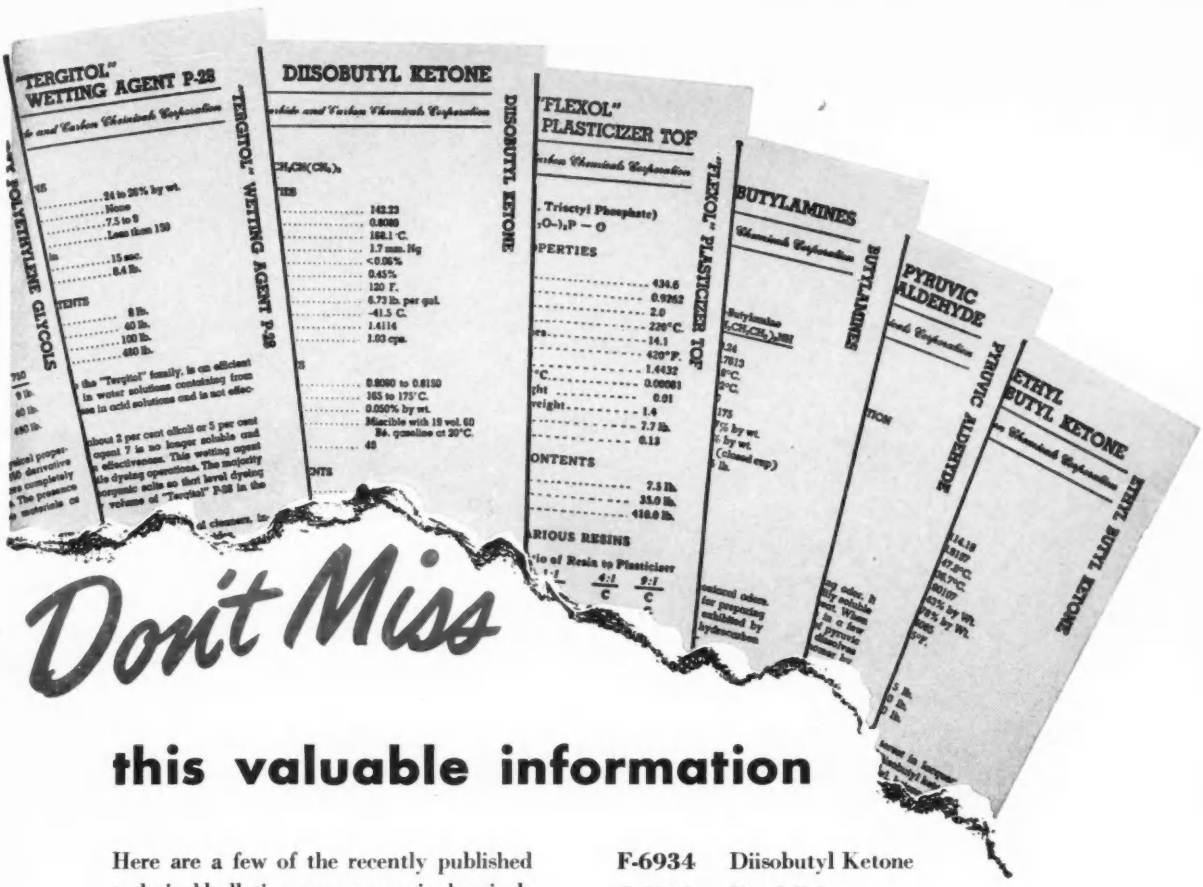
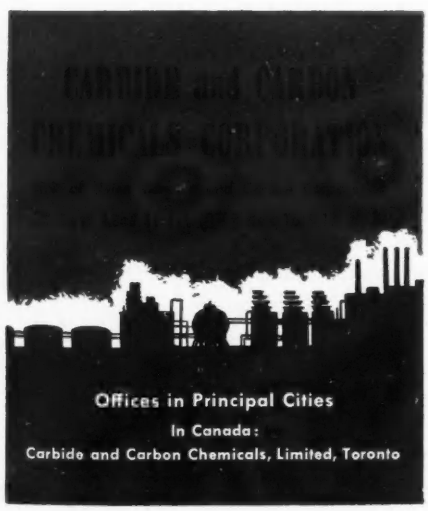


Don't Miss

this valuable information

Here are a few of the recently published technical bulletins on new organic chemicals developed by Carbide. Each of these bulletins contains helpful data and indications of uses that are potentially profitable to you. These technical bulletins should be a part of your permanent file on organic chemicals. If you have not received copies of all these bulletins, why not fill in the coupon below?

F-6934	Diisobutyl Ketone
F-6701	Vinyl Ethers
F-6159	"Flexol" Plasticizer TOF
F-6736	Methoxy Polyethylene Glycols
F-6823	Pyruvic Aldehyde
F-6860	Propylenediamine
F-6871	Butylamines
F-6906	"Tergitol" Wetting Agent P-28
F-6918	Ethyl Butyl Ketone



"Flexol" and "Tergitol" are registered trade-marks of C&CCC

Circle form numbers of literature you want—
and send the coupon to:

CARBIDE AND CARBON CHEMICALS CORPORATION
30 EAST 42ND STREET, NEW YORK 17, N. Y.

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COMPANY_____

ADDRESS_____

TITLE_____

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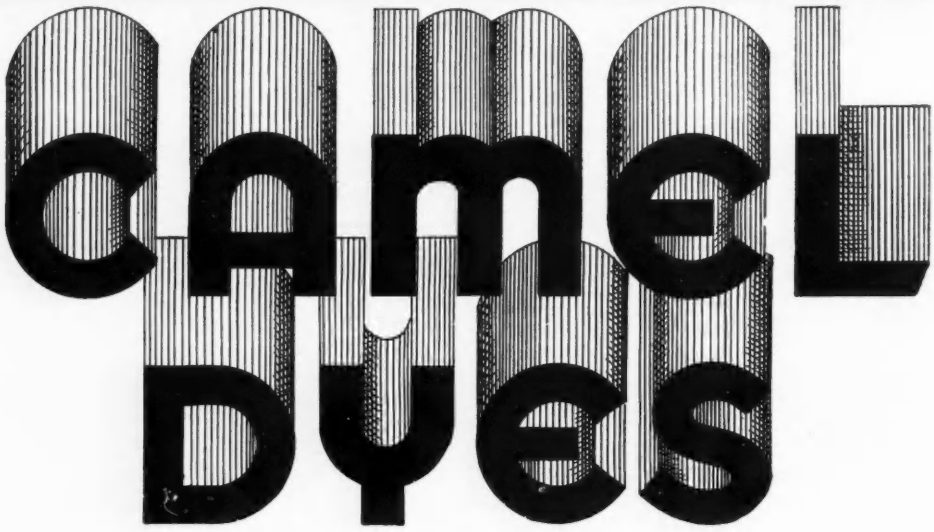

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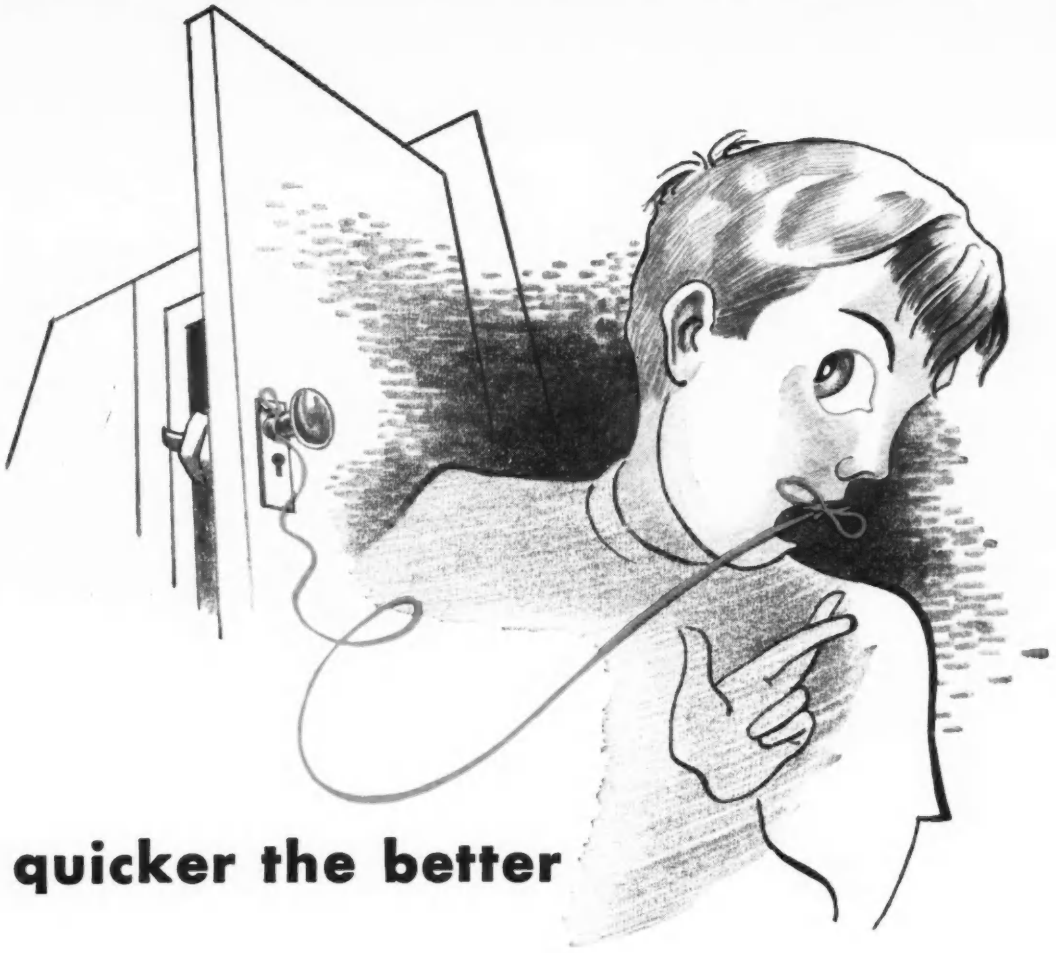

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NATIONAL QUALITY

COSTS LESS THAN SOAP

DOES MORE THAN SOAP

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*Reg. U.S. Pat. Off.

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Brown 2G produces a bright yellow Brown of excellent fastness to washing at a low cost.

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The Origin of the Coal-Tar Dye Industry

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At the time of the birth of W. H. Perkin in 1838, coal-tar was considered a nuisance. It had no value because no one had found a use for the smelly, sticky stuff. Eighteen years later Perkin was to build an industry around this nuisance and to set into motion the activities which led to the chemical revolution. Later still, nations without a great supply of coal-tar were to call themselves the "have-nots" and wage war on those nations lucky enough to have coal. It is true that in 1825 Faraday had discovered a highly inflammable, volatile substance in the condensate from coal-gas mains. This same substance was re-discovered later by Mitscherlich who obtained it by heating benzoic acid with caustic soda. He gave the substance the name "benzene" from its parent, benzoic acid. In 1845 Hofmann found benzene in coal-tar. Benzene, so far as any one knew, was perfectly useless except for small amounts that were used in a rather hazardous fashion as an illuminant and fuel. There was no effort made to recover benzene from coal-tar in large quantities and the small amount recovered was impure and very expensive.

Nor was there any use for the dozen odd other compounds known to be present in coal-tar. For example, Runge had obtained from tar an almost colorless liquid with a fish-like odor which when treated with bleaching powder gave a violet-blue color. Because of this property, Runge called the substance "Kyanol" or "blue oil". It was added to the list of chemical curiosities of the time. Useless, too, were the beautiful crystals of naphthalene (now known to house wives as "moth balls"), equally useless was anthracene, toluene and other substances now sold in tank car lots. To make the situation even worse, there was little or no real information about how the molecular units were constructed, so no adequate explanation of the chemistry of these useless compounds could be given.

Born in London, March 12th, 1838, W. H. Perkin was the son of a prosperous builder and contractor. He was the youngest son and his father had decided that he should become an architect. To this end the boy applied himself to drawing and carpentry. He became very adept at drawing and his father often used him as a copyist. He spent a great deal of his time working at the design and construction of mechanical devices and apparently excelled in this field. Young Perkin was as filled with as many diverse ambitions as the average boy and became interested in art and devoted considerable time to painting in oils. Later, all of this apparently useless and un-related training was to contribute greatly to his success in chemistry.

When Perkin was 13 years old, a friend showed him some experiments in chemistry. The boy was fascinated and at that moment chose his vocation. He would become a chemist and devote himself to the discovery of new substances. At that time the field of chemistry was one of the least attractive into which a young man could go. Perkin's father lost no time objecting to this fantastic idea, as he could see little financial promise in it. Fortunately for young Perkin, he made a change in schools during this period of decision and entered the City of London School in 1851. Here he came under the influence of Thomas Hall who had studied chemistry at the Royal College of Chemistry. Few, if any, schools gave a course in experimental science and when Hall introduced such a course it had to be given during the dinner hour as there was no place on the regular schedule for science. Hall was not only an excellent teacher but a discerning one and recognized the ability of Perkin and gave him a place as laboratory assistant, an honor which necessitated missing dinner more often than not.

Encouraged by Hall the boy sought his father's permission to enter the Royal College of Chemistry, then under the direction of the great A. W. Hofmann. His father continued to object to chemistry as a profession and it was only after Hall had intervened that he reluctantly consented to the change of schools and of career.

When Perkin entered the Royal College of Chemistry in 1853, he was 15 and the College was 8 years old. Its master, Hofmann, had been brought from Germany through the influence of the Prince Consort and probably received a salary of about $1,000 annually. By the least exacting modern standards, the 36' x 54' building that housed the college would be judged inadequate. Master and student were forced to improvise much of the apparatus used and funds for the new science were not easily available and only a few years before the founding of the College the great Liebig had said, "England is not the land of the Sciences". Yet, under the stimulus of the genius of Hofmann, great discoveries were made at the Royal College and there Perkin began the work that early destroyed a great industry and brought others, more powerful and significant into existence.

The required work of the College consisted of a series of studies in qualitative and quantitative analysis as well as special work on the analysis of gases. Perkin considered this as an introduction to his real work which he had now determined was to be chemical research. Hofmann

early recognized the genius of the boy and set him to work on an original problem. The problem was concerned with one of the coal-tar curiosities, anthracene. Hofmann wanted to prepare the amine of anthracene from nitro-anthracene and set Perkin to work preparing the nitro compound. The work resulted in complete failure, for the compound obtained was not a nitro compound at all by an oxygen compound. A second problem was assigned and solved and, by the time he was 17, Perkin had been appointed honorary assistant to Hofmann.

Organic chemists of the period 1850-75 worked under terrific handicaps. Practically nothing was known about the structure of compounds, that is, how the atoms in the molecular units were arranged in space. (Today organic chemists construct models of molecules to scale with Tinker-Toy-like sets.) Since nothing was understood about molecular structures, little could be understood about the principle of insomerism, that is, the existence of more than one compound of identical chemical composition but different properties due to difference in structure. For example, there are two hydrocarbons with the formula C_4H_{10} but of $C_{20}H_{42}$ there are 366,319 possible compounds. The organic chemist of Perkin's day had to depend on the empirical formula of the compound, this is the formula determined by analysis and tells little or nothing about the structure of the molecular unit. To make the situation even more difficult these empirical formulas were often incorrect.

As a result of this lack of knowledge of the structure of the molecule, chemists believed that it was possible to produce any desired product by synthesis provided the empirical formula was known. All that had to be done was to persuade the correct number of atoms to combine to give a formula corresponding to the empirical formula. This was known as the "additive-subtractive" method of synthesis.

It is not surprising, then, that considerable time was devoted to attempts to produce natural substances through the additive-subtractive method. Hofmann had suggested in 1849 that it might be possible to prepare quinine from naphthalene, the moth ball material, by converting the naphthalene to its amine and persuading two molecular units of this material to unite and at the same time nab two molecular units of water. Young Perkin was familiar with this method of synthesis and the remarks of Hofmann about the possible synthesis of quinine made him anxious to begin work on problems of his own choice. Hofmann required so much work of his assistants that no time was left for such work and Perkin set about to correct this by setting up a laboratory in his home in which he set to work on the synthesis of quinine.

Perkin chose allyl-toluidine as his starting material and, by the additive-subtractive method, he hoped to cause two parts of this substance to unite and at the same time add two units of oxygen and split out two units of water. This would give a compound having the empirical formula $C_{20}H_{24}N_2O_2$, quinine. This was an oxidation process and as an oxidizing material Perkin used a mixture of sulfuric acid and potassium bi-chromate. On treating the allyl-toluidine with this solution there was formed not white crystals of quinine but a dirty brown material along with a resinous goo.

Fascinated by the unexpected results from the quinine experiment, Perkin decided to try the same process using in place of the allyl-toluidine a simpler, but related compound, the "Kyanol" of Runge, then known as aniline and obtained ounce by ounce by the distillation of indigo with caustic potash. When the aniline was treated with the solution of sulfuric acid and potassium bi-chromate it blackened and formed a dark material contaminated, as was the "quinine" product, with a sticky resinous material.

At this point, Perkin began what was to be the first of a series of deviations from accepted chemical practice. He did not throw the sticky goo away. Organic chemists of his day did not waste their time on such messy stuff, preferring to work with easily purified crystalline materials.

Finding that the resinous material was quite soluble in coal-tar naphtha, Perkin removed it and had left a blackish powder. This was purified by means of wood alcohol and yielded a mass of magnificent bronze-colored crystals. In solution, these crystals gave a violet-purple color. Into a solution of the substance, Perkin dipped a piece of silk and was astonished to see that it was dyed a magnificent purple. Cotton dipped into the solution was dyed a pale lilac which washed to an even paler shade. These experiments were performed during the Easter vacation of 1856 and Perkin, barely 18, had prepared the first coal-tar dye and set the stage for the chemical revolution.

Perkin sent a sample of silk dyed with the new substance to Messrs. Pullar, of Perth, who were printers and dyers. The reply he received might be described as "cautiously enthusiastic". The Pullar firm pointed out that the best lilac used in the plant at that time was not as fast or as deep in color as that produced by Perkin and described the discovery as potentially one of the most important of the time, if the new dye did not make the cost of the cloth too high. Messrs. Pullar were justified in their caution for should an effort be made to manufacture the new dye, not a single basic raw material needed for its production was available and no methods had been designed for their production. The methods used in laboratories to produce the small amounts needed in experimental work had never been adapted to plant use since no one ever wanted more than a few pounds of any of the materials.

Through his experience as honorary assistant to Hofmann, Perkin had found that a teacher of chemistry had neither the time nor the funds to carry on private research. The way out appeared to be to make money—fast. Encouraged by his friend, Robert Church, he began the preparation of larger samples of the dye. In the summer of 1856 he had enlisted the aid of his brother, T. D. Perkin, and they had prepared several ounces of the product and August 26th, 1856, British Patent 1984 was issued to William Henry Perkin covering the production of Aniline Purple.

With larger samples prepared, the Perkin brothers visited the works of the Pullars and tried to dye on cotton. It was seen at once that the dye did not fix well with cotton and developed only the palest shade of lilac. On being tried on the printing of calico, the dye appeared to be more fast than the natural dyes used at the Pullar plant. The question of the cost of the new dye was discussed and the printers raised many objections of a technical nature to discourage Perkin.

After this discouraging visit Perkin faced the difficult task of telling Hofmann that he had decided to leave the Royal College of Chemistry to enter the new and unknown field of chemical manufacturing. Hofmann was astounded and dismayed that his most brilliant worker was to leave and was quite blunt in his denunciation of the venture as a gamble that could only lead to financial failure as well as end the brilliant research career that lay ahead of Perkin. He pointed out what Perkin already knew, that no raw materials were available for the new industry and even if they were made available the price would probably be too great to permit use of the dye. He called attention to the prejudice of the calico printers and dyers; these artists would not be persuaded easily to give up materials and methods that had stood the test of years in favor of an untried and fantastic scheme directed by a boy of 18.

Among the dyes with which Aniline Purple would be competing was alizarin, obtained from madder root. This plant was cultivated in Southern Europe and France, India, Java and N. E. Asia. It was one of the most ancient of dyes, having been used to dye mummy cloths, and in the days of Herodotus the Libyan women dyed their cloaks with its brilliant red.

It was the Turkey Red of English dye trade and represented a tremendous industry. The importance of alizarine to the economy of the nations engaged in its production can be judged by the fact that Louis Phillippe ordered the French soldiers to wear trousers dyed with the brilliant red of madder in order to stimulate a greater use of the material. It was not until 1914 that this somewhat un-military color was abandoned. Equally important and as ancient was indigo. It was the only important fast blue used up to the last of the 19th century. It was cultivated in India in huge acreages and efforts were made to introduce it in the American Colonies. The effect of the introduction of synthetic methods for the production of indigo had a tragic effect in India. It has been claimed by authorities that upward of a million Hindus starved when the cultivation of indigo was no longer a source of income for these people. There were other important natural dyes used but none in as large quantities as alizarin and indigo. Of historical interest was the Purple of Tyre, obtained from shell fish along the Mediterranean. So rare and dear was this dye that its use was restricted to Kings, Emperors, and Court Dignitaries. To be able to "wear the purple" was tantamount to identification with Royalty. Certainly Hofmann was justified in pointing out that dye got from coal-tar would have tough sledding against such ancient materials.

After leaving the Royal College of Chemistry, Perkin visited some of the Scotch calico printers and carried samples of Aniline Purple for trial. Here casein was used to fix the dye to the cloth and worked very well but the Scotch were unimpressed and showed little interest even if it were possible to obtain the dye fairly cheaply. At about the same time, Messrs. Pullar advised that unless the dye could be used by the calico printers that the amount that would be used by dyers alone would not be sufficient to warrant the investment of money in the project. The only bright spot in the picture was furnished when R. Pullar advised Perkin to take to dye to the prominent silk dyer, Thomas Keith. At the Keith plant it was found that silk took the dye without a mordant and was dyed a fast intense color. Keith was enthusiastic and advised Perkin to go ahead with his plan for commercial production of Aniline Purple.

Ironically enough, it appears that the only financial backing Perkin had was that of his father who five years before had denounced chemistry as a poor risk, even as a career. He invested almost all of the savings of a lifetime in the project. The Perkin Works were located at Greenford Green, near Harrow, and work on the plant was started in June, 1857.

The basic material needed for the preparation of Aniline Purple was aniline. This material had long been a laboratory curiosity and had been known under four different names. It was the "blue oil" found by Runge in coal tar. It had been obtained by Unverdoben in 1826 as a product of the distillation of indigo and, because it formed solids with acids, he gave it the name "crystalline". Later, Fritsche obtained it by distilling indigo with potash and it was he who called it aniline from the Arabic word "el-anil" for indigo. Shortly after this, Zinnin reduced nitro-benzene and obtained what he called "benzidam". In 1843, Hofmann showed that all these were one substance, aniline. Efforts by the Perkin brothers to secure aniline in quantity from coal-tar failed. The difficulties of purification were great and the yield very small. The distillation of indigo with potash was even more costly and could not be used as a source of supply. The method of Zinnin, the reduction of nitro-benzene with hydrogen sulfide, was not very satisfactory but it had been modified by Bechamp, who got good results using acetic acid and iron to reduce the nitro-benzene. It was this method that Perkin finally set out to adapt to the commercial production of aniline.

The problem now was to prepare nitro-benzene in large amounts. There had never been any demand for nitro-benzene and it was not available in commercial quantities. Soap manufacturers in France used very small amounts of the poisonous substance to scent soap but the amount used hardly called for mass production. Perkin found that nitro-benzene was easily prepared by treating benzene with fuming nitric acid—but fuming nitric acid was not a commercial product and was very expensive. After considerable work, it was found that the benzene could be nitrated by using a mixture of nitrate of soda and sulfuric acid. Benzene would have to be obtained for the preparation of the nitro-benzene and Perkin arranged with several coal-tar distillers to furnish a supply. The benzene was very impure and its quality varied from batch to batch and re-distillation was carried out at the Perkin Works. It cost about $1.00 to $1.25 a gallon. Today, it can be bought in car lots at about 15 cents per gallon.

One of the first devices used at the Perkin Works for what was at that time mass production of nitro-benzene had a capacity of 30-40 gallons. The reaction vessel consisted of a cast-iron cylinder with a hand-operated crank fitted through the front end and running the full length of the cylinder. The back end of the cylinder could be opened and was equipped with a tightly fitted lid (somewhat like a solid man-hole cover) which could be screwed into place by means of a clamp. Two stacks were set in the top of the cylinder about one-third of the way from each end of the device and one was used to feed chemicals into the vessel and the other served as a safety valve and take-off for end products. In preparing nitro-benzene in this vessel, the nitrate of soda was put in at the back end of the cylinder and the lid clamped in place and the benzene and sulfuric acid run in at the in-take stack. The acid reacted with nitrate of soda to form nitric acid which in turn reacted with the benzene to form nitro-benzene. During this process fumes of disagreeable and dangerous oxides of nitrogen were set free and great amounts of heat liberated but while all of this molecular rioting was going on, a workman turned the crank to operate the stirrer. Despite the safety stack there were many explosions, but no workman was seriously injured.

The preparation of aniline from the nitro-benzene was conducted in the same type of vessel used for production of nitro-benzene except an arrangement was made to heat the vessels. At first, acetic acid and iron were used to reduce the nitro-benzene but later the less expensive hydrochloric acid was used. The iron was in the form of finely divided particles and was put in the vessel first and the nitro-benzene and acid added later. The danger of explosions in this process was so great that workmen stood watch over the reaction vessel and if the reaction became too violent they poured water on the iron cylinder thus cooling the mixture and retarding the reaction rate. When the reaction was judged complete, a fire was put under the vessel and the aniline distilled.

Just six months after the Perkin Works opened, Aniline Purple was on the market. In six months, an entirely new set of industries were set going, for the manufacture of Aniline Purple called for quantities of benzene, nitro-benzene and aniline never before used. Today the Perkin plant would be considered as about the equivalent to a pilot plant used to test new processes on a small scale. The chemical success of Aniline Purple outran its financial success. The only plant using it was that of Keith, the silk dyer, and even here difficulties soon appeared. Silk took the Aniline Purple so rapidly that it did not dye smoothly but was uneven and spotty.

Young Perkin now had to discover methods to apply Aniline Purple or he, his brother, and father faced a rather heavy financial loss. The solution to the problem of dyeing silk with the new dye was amazingly easy. All that was needed was the use of a soap solution in the

(Concluded on Page 326)

Effect of Laundering on Gas Fading Performance of Rayon Fabrics

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Introduction

RECOGNITION of the fact that laundering may affect the performance of a fabric which is subjected to gas fading is given in the current tentative gas fading test method of the American Association of Textile Chemists and Colorists *(1)*, which specifies that a laundered specimen as well as a specimen of the original fabric shall be subjected to the test. The probability that laundering will remove or disturb the finish on a fabric, and thereby alter its susceptibility to gas fading, unquestionably constitutes the reason for this provision.

It was the purpose of the present investigation to study the effect of a preliminary laundry treatment on the gas fading of representative rayon fabrics.

Methods of Procedure

Test Fabrics

Eleven rayon fabrics representing the two principal rayon types—regenerated and cellulose acetate rayon in a variety of weaves and with a range of dye and finish types were selected for this investigation.

They are described as follows:

Fabric Number 1—Blue print viscose rayon twalle;

Fabric Number 2—Rose and gray print rayon viscose twalle;

Fabric Number 3—Blue gabardine of spun viscose rayon;

Fabric Number 4—Tan gabardine of cotton and spun viscose rayon;

Fabric Number 5—Red Salyna of cotton and spun viscose rayon;

Fabric Number 6—Pink tricot knit of cellulose acetate rayon;

Fabric Number 7—Chartreuse taffeta of cellulose acetate rayon;

Fabric Number 8—Light blue satin of cellulose acetate rayon;

Fabric Number 9—Green crepe of viscose and cellulose acetate rayon;

Fabric Number 10—Blue crepe of viscose and cellulose acetate rayon;

Fabric Number 11—Violet faille of viscose and cellulose acetate rayon and wool.

The first eight of this group of fabrics were secured from different manufacturers through the assistance of the American Viscose Corporation. The other three were purchased in department stores in New York City.

A *control* fabric, used to determine the end-point of the test, consisted of a cellulose acetate satin which was dyed with 1.0 per cent Celanthrene Brilliant Blue FFS, according to a slightly modified version of the methods prescribed in the 1945 Yearbook of the American Association of Textile Chemists and Colorists *(6)*.

Dye and Finish Identification

The dyes used on the test fabrics were identified by chemical tests. The procedure as given by Green *(2)* supplemented by private advice from Charles Seibert of the du Pont de Nemours Company, and Arthur Wachter of the American Viscose Corporation for the identification of dye types was followed. The finishes were identified in the laboratories of the American Viscose Corporation.

Results of the analyses for the types of dyes and finishes on the respective fabrics are shown in Table I.

Gas Fading Apparatus

Except for a few modifications, the gas fading apparatus was built according to a blueprint provided by the American Association of Textile Chemists and Colorists. In the use of this equipment, the test samples were exposed to air which had passed through the flame of a lighted gas burner. A complete description of

TABLE I
Dye Identification of the Experimental Fabrics

Fabrics	*Type of Dye*	*Type of Finish*
1. Blue Twalle		
Backgrouid		
Blue	Direct	Tertiary amine hydro-acetate
Printed Design		
Black	Thioindigoid vat	
Gray	Thioindigoid vat	
Rose	Anthraquinone vat	
Yellow	Thioindigoid vat	
Green	Anthraquinone vat	
2. Pink Twalle		
Background		
Rose	Direct	Tertiary amine hydro-acetate
Printed Design		
Gray	Thioindigoid vat	
Black	Thioindigoid vat	
3. Blue Gabardine	Direct	Amine salt of a fatty acid amide
4. Tan Gabardine	Anthraquinone vat	Alkali-soluble cellulose ether
5. Red Salyna	Diazo and Developed	Resins which are polymers of acrylic acid esters
6 Pink Tricot	Direct on Acetate Rayon	Long chain alcohol sulfate
7. Chartreuse Taffeta	Direct on Acetate Rayon	Aliphatic aminoethyl amide
8. Light Blue Satin	Direct on Acetate Rayon	Long chain alcohol sulfate and a mixture of amino fatty compounds
9. Green Crepe	Direct	Alkylolamide
10. Blue Crepe	Direct	Sulfonated and free cetyl alcohol
11. Violet Faille	Direct	Polyhydric alcohol ester

[1] Deceased March 1, 1947.

TABLE II

Comparison of the Effect of One Period of Exposure on the Color of Unlaundered and Laundered Fabrics

Fabrics	Results of Visual Inspection				Results of Reflectometer Readings	
	Unlaundered Specimens		Laundered Specimens		Unlaudered Specimens	Laundered Specimens
	Description of Specimens	Rating (Class)	Description of Specimens	Rating (Class)	(Units of Color Difference)	(Units of Color Difference)
1. Blue Twalle						
Blue	No change	I	No change	I		
Black	No change	I	No change	I	Multiple Print	Multiple Print
Gray	No change	I	No change	I		
Rose	No change	I	No change	I		
Yellow	No change	I	No change	I		
Light Green	No change	I	No change	I		
Dark Green	No change	I	No change	I		
2. Rose Twalle						
Rose	Slightly yellowish	II	Slightly yellowish	II		
Light Gray	No change	I	No change	I	Multiple Print	Multiple Print
Dark Gray	No change	I	No change	I		
Black	No change	I	No change	I		
3. Blue Gabardine	No change	I	No change	I	0.5	0.5
4. Tan Gabardine	No change	I	No change	I	1.1	1.1
5. Red Salyne	No change	I	No change	I	0.0	0.0
6. Pink Tricot	Lighter, yellowish	III	Lighter, yellowish	III	7.0	8.8
7. Chartreuse Taffeta	No change	I	No change	I	2.8	2.0
8. Light Blue Satin	No change	I	No change	I	0.6	0.6
9. Green Crepe	Yellowish	IV	Very slightly yellowish	IV	4.4	3.3
10. Blue Crepe	Duller, slightly purple	IV	Slightly duller	IV	7.9	4.8
11. Violet Faille						
a. Satin side	Slightly pinkish	IV	Pinkish-change greater than in unlaundered specimen	IV	14.4	16.2
b. Dull side	Pinkish	III	Pinkish	III	5.9	7.8

the apparatus has been given in a previous report by Ray *(3)*.

Preparation and Arrangement of the Specimens

In preparation for the gas fading test, portions of each test fabric were laundered and other portions were retained in the original state. The laundering treatment consisted in washing the fabric in a 0.5 per cent neutral soap solution for 20 minutes at 38 ± 1° C, followed by two five-minute rinses at the same temperature, and ironing or steam-pressing at 125° to 130° C, according to the nature of the fabric.

Four specimens of each fabric—two unlaundered and two laundered—were cut to a length of five and three-fourths inches in the warp, and to a width of five inches in the filling direction. Hems were basted in the ends of each specimen, so that the finished length was four and one-half to four and five-eighths inches. The glass rods from which the specimens were to be suspended were inserted in the upper ends. In the lower ends were placed glass rods, used to prevent agitation of the fabrics by the oven fan, and also to permit a more uniform mixture of the gases throughout the oven during the testing.

Only the four specimens of a single fabric were exposed at one time in the test chamber. These were suspended from the rods in the middle portion of the oven. Preliminary investigations had shown that uniform fading was obtained throughout the oven under the conditions herein described.

Comparison of the Effect of Exposure on Laundered and Unlaundered Specimens

The two unlaundered and two laundered specimens of each fabric were subjected to one gas fading test period according to the 1945 test method of the American Association of Textile Chemists and Colorists *(6)*. This was done in order to determine the state in which the fabric was more sensitive, there being a possibility that some finishes which might be removed or disturbed by laundering would tend to accelerate the fading and others to inhibit it. In addition, pH determinations were made on unexposed laundered and unlaundered specimens, in order to check the theory that a finish with an acid reaction will fade more rapidly than one which is alkaline, as suggested in a discussion following a report by Seibert *(4)*.

Determination of Color Changes

Following the exposure treatment, the two sets of specimens of each fabric—laundered and unlaundered—were evaluated for color change visually as well as by means of the reflectometer.

The methods of evaluating color changes (both by visual judgment and by units of color difference calculated on the basis of reflectometer readings) have been described in a previous report by Ray *(3)*.

As a basis for determining the range of the units of color change for a given fabric, determinations of color differences in three different areas of the original specimen were made, and the highest and lowest differences were recorded.

pH Determinations

A method adapted from that of Wake-

TABLE III

pH Determinations on Laundered and Unlaundered Specimens of Experimental Fabrics

	Fabrics	*Boiled Distilled Water*	*Blank*	*Unlaundered Fabrics*	*Laundered Fabrics*
1.	Blue Twalle	7.2	6.1	6.2	6.4
2.	Rose Twalle	7.2	6.1	6.3	6.5
3.	Blue Gabardine	6.3	6.3	6.4	7.0
4.	Tan Gabardine	7.2	6.1	6.8	6.3
5.	Red Salyna	6.7	6.7	6.9	7.1
6.	Pink Tricot	7.0	7.0	5.9	5.8
7.	Chartreuse Taffeta	6.9	6.2	6.1	5.8
8.	Light Blue Satin	7.0	7.0	6.7	6.5
9.	Green Crepe	7.0	6.9	6.8	6.5
10.	Blue Crepe	7.0	6.9	6.8	6.7
11.	Violet Faille	7.0	6.9	7.5	7.2

ham and Skau *(5)* was used for pH determinations. These authors defined the pH of a fabric as the pH of its moisture content at standard conditions (21° C. and 65 per cent relative humidity). They found that the smaller the amount of water used, the more accurately did the pH obtained represent that of the original air-dried fabric. Their method involved determinations on extractions ranging from three to 30 c.c. of water for a given two-gram sample. The values then were plotted and the pH of the air-dry fabric determined by extrapolation. All extractions were made at room temperature because of the possibility that a hot extraction might result in decomposition of materials in the cloth, and thus lead to abnormal values.

A Number 7662 Leeds and Northrup pH Indicator with a glass electrode and a calomel reference electrode was used for the pH determinations reported herein. In preparing specimens for the tests, the fabrics first were ground finely in a Wiley Mill. Two samples, each weighing 2 ± 0.1 grams then were weighed out for duplicate determinations on each test fabric. Each was placed in a small beaker and 20 c.c. of boiled carbon dioxide-free distilled water were added. The fabric was worked with a spatula until the mass was uniformly wet. The beaker was covered with a watch glass, allowed to stand for 30 minutes, and again stirred. The cloth then was pressed against the side of the beaker with the spatula, and 15 c.c. of liquid were squeezed out and poured into the cup of the potentiometer. (This was found to be the amount necessary to cover the bulbs of the electrodes used.)

The electrodes were rinsed with distilled water before each measurement. In making the measurements, the reading was taken two minutes after pouring the test solution into the cup.

To offset the possible variations which might occur from day to day, the pH values both for laundered and unlaundered specimens of a given fabric were determined on the same day. Duplicate measurements checked within 0.1 unit.

For each series of determinations, duplicate tests were made on a blank of distilled water allowed to stand in a covered beaker for 30 minutes before a measurement was made.

Presentations of Findings with Discussion

Color changes as shown by visual inspection under the standardized conditions used, as well as by the calculation of the units of color difference from reflectometer readings are given in Table II, and pH changes in Table III.

Table II shows that, according to the color change ratings made by visual inspection, the unlaundered and laundered test specimens fell into the same class after one exposure to the gas fading test under the conditions specified, although the color designations recorded by the evaluator showed differences in Fabrics 9, 10, and 11 which were not sufficiently great to place them in different visual rating classes.

Since finer distinctions of color change are possible with the reflectometer than by visual inspection, a comparison of the calculated units of color difference of the test specimens with readings on three separate areas of the unexposed fabric is in order. This is as follows:

Test Fabrics		*Findings from Reflectometer Readings*
Fabrics 1 and 2, multiple prints, can not be read by means of the reflectometer;		
Fabric 3.	Units of color difference in unlaundered test fabric	0.5
	Units of color difference in laundered test fabric	0.5
	Range of values in three areas of the unexposed fabric	0.0
	Conclusions concerning difference between unlaundered and laundered test specimens	No difference
Fabric 4.	Units of color difference in unlaundered test fabric	1.1
	Units of color difference in laundered test fabric	1.1
	Range of values in three areas of unexposed fabric	0.6
	Conclusions concerning difference between unlaundered and laundered test specimens	No difference
Fabric 5.	Units of color difference in unlaundered test fabric	0.0
	Units of color difference in laundered test fabric	0.8
	Range of values in three areas of unexposed fabric	0.8
	Conclusions concerning difference between unlaundered and laundered test specimens	No difference
Fabric 6.	Units of color difference in unlaundered test fabric	7.0
	Units of color difference in laundered test fabric	8.8
	Range of values in three areas of unexposed fabric	2.6
	Conclusions concerning difference between unlaundered and laundered test specimens	No difference

Test Fabrics		*Findings from Reflectometer Readings*	
Fabric 7.	Units of color difference in unlaundered test fabric	2.8	
	Units of color difference in laundered test fabric	2.0	
	Range of values in three areas of unexposed fabric	0.5	
	Conclusions concerning difference between unlaundered and laundered test specimens	No marked difference	
Fabric 8.	Units of color difference in unlaundered test fabric	0.6	
	Units of color difference in laundered test fabric	0.6	
	Range of values in three areas of unexposed fabric	2.1	
	Conclusions concerning difference between unlaundered and laundered test specimens	No difference	
Fabric 9.	Units of color difference in unlaundered test fabric	4.4	
	Units of color difference in laundered test fabric	3.3	
	Range of values in three areas of unexposed fabric	0.9	
	Conclusions concerning difference between unlaundered and laundered test specimens	Slight difference, with change greater in unlaundered fabric	
Fabric 10.	Units of color difference in unlaundered test fabric	7.9	
	Units of color difference in laundered test fabric	4.8	
	Range of values in three areas of unexposed fabric	2.0	
	Conclusions concerning difference between unlaundered and laundered test specimens	Difference, with change greater in unlaundered fabric	
		Satin Side	*Dull Side*
Fabric 11.	Units of color difference in unlaundered test fabric	14.4	5.9
	Units of color difference in laundered test fabric	16.2	7.8
	Range of values in three areas of unexposed fabric	0.5	0.9
	Conclusions concerning difference between unlaundered and laundered test specimens	Distinct difference, with change greater in laundered fabric	

The three fabrics which showed some difference in color change after one exposure to a gas fading test in the unlaundered and laundered condition, respectively, as calculated from reflectometer readings were the same as those on which the descriptions differed slightly during visual inspection. These were Fabrics 9, 10, and 11. The first two, namely—Fabrics 9 and 10 exhibited somewhat greater changes during a gas fading test of the unlaundered than of the laundered fabric, while the reverse was true of the third fabric, or Fabric 11. All three fabrics were dyed with direct dyes, but each had a synthetic finish of a distinct type. Fabrics 9 and 10 had an initial pH in the unlaundered fabric of 6.8 while Fabric 11 was pH 7.5

These three fabrics had a point in common of being dyed with direct dyes; but other fabrics in the study likewise were colored with this type of dye. The finishes were not similar in the three cases; and, although all had initial pH values which were among the highest of any of the experimental fabrics, there were other fabrics in the series with values as high as that of Fabrics 9 and 10.

The pH of all the fabrics ranged from 5.8 to 7.5; the highest difference between unlaundered and laundered specimens was 0.6, in the case of the Blue Gabardine. The difference in degree of acidity or alkalinity, as measured in this investigation, does not account for differences in behavior of laundered and unlaundered specimens exposed to gas fumes. The pH determinations for the Green Crepe (Fabric 9), the Blue Crepe (Fabric 10), and the Violet Faille (Fabric 11), were lower for the laundered than for the unlaundered specimens. Yet the first two of these fabrics faded more before laundering, while the latter faded more after the application of the laundering process.

No relationship has been established, therefore, between dye type, finish type, and initial pH of a fabric and its performance in one exposure to a gas fading test as applied in this study. The possibility exists that a relationship might have been found had a wider variety of fabrics been used, or had repeated applications of exposures been made.

Summary

When a one-exposure gas fading test was applied to 11 rayon fabrics representing a wide range of dye and finish type, before and after laundering, eight fabrics showed no difference in response whether they had been laundered or not, two showed a greater gas fading color change before laundering than after, and one changed more after laundering than before.

The performance of the fabrics was not related to the dye or finish types or to the initial pH of the fabrics.

Acknowledgments

Sincere appreciation is expressed:

To Dr. Pauline Beery Mack, Director, as well as to staff members of the Ellen H. Richards Institute for advice and assistance in the conduct of the study; and

To the American Viscose Corporation, under whose sponsorship this investigation was conducted as a part of a fellowship maintained at the Ellen H. Richards Institute, The Pennsylvania State College.

This is the third in a series of reports on methodology studies related to gas fading, from the laboratories of the Ellen H. Richards Institute, sponsored by the American Viscose Corporation.

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Coal-Tar Dye Industry—

(Concluded from Page 321)

dye bath and Aniline Purple dyed silk evenly and intensely. Despite this early success with the dyeing of silk the chief market for dyes, calico printing, remained closed to Aniline Purple. None of the mordants used by dyers and printers would fix the Aniline Purple to cotton. Shortly after the appearance of the new dye on the market in England, the French began to manufacture it (Perkin's French patent was invalid) under the name "Mauve"—and achieved in moderate success. Pullar now joined with Perkin in the search for a proper mordant and together they found that if the yarn to be dyed was first treated with a solution containing tannic acid, dried, then treated with a salt of tin or of aluminum that the dye took smoothly and developed an intense purple color. Fortunately, a little bit of "Mauve" went a long way, for if it were sold on a weight for weight basis its price was the same as platinum! Perkin estimated that 100 pounds of coal would produce about one-quarter of an ounce of "Mauve".

The success of "Mauve" was amazing. It was the topic of conversation everywhere. The people of that time were as astonished at the idea of obtaining so lovely a color from coal-tar as the 1945 citizen was at the atomic bomb. An actor used it in a line in a play of the day. He complains that all he hears about is "Mauve", and adds, "Why, even the policeman says to you 'Mauve on'!".

On the heels of "Mauve" came a host of dyes. Every chemist in England and on the Continent set to work to find new dyes. Hofmann joined the race and produced a series of beautiful dyes of lovely blue and violet. The Perkin brothers met all of this competition by introducing better methods of manufacture and taking full advantage of the introduction of new products. At one time they were producing eight dyes at Greenford Green.

In order to complete the story of the contribution of Perkin to the chemical revolution it is necessary to give a brief account of the development of one other product. In 1868 Graebe and Liebermann, two German workers, succeeded in preparing Alizarin, a color obtained from madder root, from anthracene, one of the coal-tar curiosities. This was the first case of the synthesis of a natural dye. The method used by Graebe and Lieberman was useless commercially and Perkin set to work to discover a method that would work on a large scale. He returned to his first failure, the oxygen compound he had obtained while attempting to nitrate anthracene. He had saved samples of the material from his Royal College days and on re-examination of the material found that what he had prepared was anthraquinone. When Perkin was working on anthracene the commonly accepted empirical formula was $C_{15}H_{12}$, this was shown to be incorrect and in the light of the correct formula [$C_{14}H_{10}$] the early work of Perkin made sense. Perkin set to work to prepare alizarin from anthraquinone and worked out two methods which had commercial possibilities. One called for the use of fuming sulfuric acid which was not available in England at that time and the second method was adapted to commercial use. For those who have indulged in wishful thinking about the possibility of keeping a scientific secret, it is interesting to observe that Graebe, Lieberman, and Caro, working independently of Perkin, arrived at exactly the same method! There was a difference of one day in the dates of their respective patents!

To prepare Alizarin on a large scale meant that a supply of anthracene must be had. Perkin sent his brother, T. D. Perkin, on a tour of England during which he visited almost every coal-tar plant in the Kingdom. He taught the distillers how to recover anthracene from coal-tar and how to run a crude test to determine its purity. He contracted to buy all the anthracene that the distillers produced. In this way the Perkin Works had an assured supply of anthracene and what amounted to a monopoly on the market for the crude material. The crude material was purified at the Perkin Works and, after some minor technical difficulties, production of Alizarin was commenced at Greenford Green. In 1869 one ton was produced and by 1871 the production was 220 tons. In a few years the madder root industry had practically disappeared. It was one of the first victims of the chemical revolution. By 1873, the demand for Alizarin was so great that the Greenford Green Works would have had to be trebled to meet the demand, and Perkin, now 36 and fairly wealthy, decided to sell the plant in order to devote his full time to research.

Perkin had not waited until retirement from the industry to conduct research. In 1858, when busiest with the development of "Mauve", he published (with Duppa) an article on the preparation of amino-acetic acid. This substance, which is the first of the important series of substances called "amino acids", had hitherto been available only from natural sources. In about nine years his work on the preparation of coumarin appeared. This is a substance found in the Tonka bean and now used in the preparation of artificial vanilla. It was probably one of the first such natural substances to be prepared by synthesis. Later, he had published the details of the reaction that now bears his name, the Perkin Reaction, which is a method for preparing substituted unsaturated aromatic acids. This reaction was used in the work of von Baeyer and Caro on the synthesis of indigo, leading to the disruption of another industry.

It is not possible to evaluate the contribution of Perkin to society. He founded a new and tremendous industry on what had been a waste product. In 1856 the coal-tar chemical industry had no value, but by 1878 the coal-tar dye and related industries amounted to 3,150,000 pounds sterling. He gave to England the opportunity to dominate the chemical world, an opportunity not well used, for Germany rapidly assumed the leadership in the field. He made research possible through chemical industry by placing at the disposal of research workers large amounts of substances hitherto unavailabe.

—♦ ♦—

• Endorse Revision of Rayon Definition

A. M. Tenney and A. G. Scroggie, respectively, Chairmen of the Subcommittees on Man-Made Fibers and on Definitions, American Society for Testing Materials, Committee D-13 on Textiles, advise that the balloting now progressing with respect to a revision of the definition of rayon is running roughly 10 to 1 in favor of the changes proposed at the meeting of Committee D-13 last March.

Both questions, namely: (1) "Do you favor restricting the term "rayon" to fibers and yarns composed of regenerated cellulose?" and (2) "Do you agree to coining a word as a generic term for fibers and yarns composed of esters of cellulose?" have been very emphatically endorsed. Opinion on the selection of a coined term as required by Question 2 is not as decisive and balloting is continuing.

Following approval by these subcommittees the questions will be submitted by letter ballot to Committee D-13 as a whole. If this Committee gives its approval the definitions will then be submitted to the American Society for Testing Materials at the Annual Meeting of the Society, with recommendation for adoption as tentative standards.

Proceedings of the

American Association of Textile Chemists and Colorists

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MAY 17, 1948

Joint Meeting, NNE Section and LTI Student Chapter

THE second annual joint meeting of the Northern New England Section and the Lowell Textile Institute Student Chapter was held on Friday, April 16, in Southwick Hall at Lowell Textile Institute. The complete program was arranged and presented by the Student Chapter. The comments of the Northern New England members were very gratifying.

An open forum discussion preceded the dinner. Six student members participated:

Miss Theresa Comerford.
Miss Joan L. Gregg.
Robert E. Morrison.
Robert J. Pierent.
Herbert M. Lachut.
Laurence F. McMahon.

George Kenniston of the Student Chapter Program Committee acted as Moderator. The topic for discussion was "Should Co-operative Education Be Developed at Lowell Textile Institute in Such a Manner that Actual Industrial Experience Be a Requirement for Graduation?" Approximately one hundred guests attended.

Dinner was served at 7:00 P.M. in Southwick Hall with one hundred forty members and guests in attendance. This number included forty-five students. After the dinner Peter J. McKone, Chairman for the evening's program, introduced Kenneth R. Fox, President of Lowell Textile Institute. President Fox welcomed the guests to Lowell on behalf of the Board of Trustees and the faculty of Lowell Textile. He complimented the Northern New England Section on the co-operation given to the Student Chapter in arranging the program.

Mr. McKone then presented George O. Linberg, Chairman of the Northern New England Section. Mr. Linberg announced that the Northern New England Section had established a Scholarship Fund for Chemistry students entering their senior year at Lowell Textile Institute. A committe consisting of the Faculty Advisor of the Student Chapter, the Head of the Chemistry Department at Lowell Textile Institute, the Dean of Lowell Textile Institute, the Vice-Chairman of the Northern New England Section, the Treasurer of the Northern New England Section, and the Senior Council Representative from the Northern New England Section, was appointed. The Faculty Advisor was named Chairman. The winner of this year's award will be announced in September.

Mr. Linberg then introduced Kenneth H. Barnard, Conventional Chairman for the AATCC. Mr. Barnard announced that arrangements had been made for a special train to carry New York and New England members to the national convention in Augusta, Georgia, and asked that reservations be made as soon as possible.

John M. Roughan of the Program Committee introduced the following speakers:

Melvin Siegel, '48—"Photographic Aids to the Textile Industry".

Professor John H. Skinkle—"A New Method of Evaluating Water Resistance of Textiles".

Allen Frank, '48, and Stephen Ruffenach, '50—"Fire and Textiles".

Ater a short question period the meeting was brought to a close.

Respectfully submitted,

Lawrence C. Gardner, *Secretary.*

Summer Outing, Piedmont Section

PLANS for the summer outing of the Piedmont Section at the Ocean Forest Hotel, Myrtle Beach, S. C. on June 18th and 19th have been completed.

Scheduled for Saturday at 1:00 P.M. will be a buffet luncheon and fashion show for the ladies; there will be dancing both Friday and Saturday nights and a banquet is scheduled for Saturday night. In addition to bathing and fishing there will be shuffle board, tennis and a putting green available to guests.

Hotel reservations should be made directly with the hotel.

Report, Clemson Student Chapter

THE Clemson Student Chapter met on February 23, 1948 to discuss the adoption of a constitution and to plan for future meetings. It was decided to hold informal meetings on the first and fourth Mondays of each month, and a committee was appointed to draw up the constitution.

On March 1 the constitution was adopted and the first meeting was planned for April 5, 1948. The following officers were elected:

Chairman—A. M. Hand.
Vice Chairman—J. L. Heaton.
Secretary—R. H. France.
Treasurer—G. F. Hemphill.

Joseph Lindsay was elected as faculty advisor.

The meeting was held on April 5, at which time two films were shown entitled "Silk Printing" and "Portrait of an Industry". The meeting was adjourned after a short discussion on the possibilities of a steak supper some time in May.

Respectfully submitted,

Roy H. France, *Secretary.*

Report, Bradford Durfee Student Chapter

THE first official meeting of the Bradford Durfee Technical Institute Student Chapter was held Monday, April 12th, 1948 in the school auditorium.

William H. Wingate, faculty advisor, conducted the meeting until Paul N. Dargie was elected Chairman, and Clyde Newland Secretary.

It was unanimously voted to hold bimonthly meetings; one to be a regular business meeting and one to be reserved for a speaker.

George Bedard was appointed by the chairman to find a place where the meetings shall be held, also to establish the time and date.

The charter members present at this meeting were:

Richard Barber, George Bedard, Leonard Connors, Paul N. Dargie, Stanley Deubiel, Robert A. Dubreail, Walter Kennedy, Robert Lebrum, James Manolis, Albert Medas, Jack Moss, Clyde Newland. David Sanders, Raymond Wishart.

Respectfully submitted,

Clyde Newland, *Secretary.*

Twenty-Seventh Annual
Meeting and Convention
Sheraton Bon Air Hotel, Augusta, Georgia
October 21-23, 1948

General Plans

GENERAL plans and committee personnel for the Twenty-Seventh Annual Meeting and Convention to be held at the Sheraton Bon Air Hotel, Augusta, Georgia, October 21-23, have been announced by General Chairman Douglas C. Newman, Sales Manager, Southern District, Organic Chemicals Department, E. I. du Pont de Nemours & Co., Inc. The three Southern Sections, Piedmont, South Central and Southeastern, will be joint hosts.

The theme of the convention "ADVANCING TEXTILES THROUGH RESEARCH" will be closedy adhered to in the program which is given briefly later on in this announcement.

Committee chairmen for the Augusta convention were called to Augusta for a preconvention meeting on May 8th at which time detailed plans for the work of each committee were rviewed and rehearsed. Every detail that will make for your comfort, convenience, pleasure and inspiration has been carefully considered, and it is felt that your sacrifice of time and expense will be well rewarded in attending the Augusta convention. Hotel reservations are not being accepted yet, but it is confidently felt that adequate facilities will be available for every member attending. Further details on reservations will be announced at a later date.

Program

Thursday, October 21

9:30 A.M.—Registration.
9:30 A.M. to 2:00 P.M.—Personnel Service.
9:45 A.M.—National Council Meeting.
12:30 P.M.—Luncheon for National and Sectional Officers and members of National Council.
2:00 P.M. to 5:00 P.M.—General Technical Program.
5:00 P.M.—Annual Business Meeting.
7:30 P.M.—Informal Dinner Honoring Corporate and Charter Members (Feature: Presentation of Olney Medal.)

Purpose of the Convention

"There have been many changes in the textile industry over the past decade and it has been particularly noticeable that during the past few years this industry has been research conscious. The American Association of Textile Chemists and Colorists is one of the oldest organizations in this country allied with the manufacture of textiles that has sponsored research, and realizing that all major developments have been produced through these means, it is our hope that inspiration will be created at this national meeting for 'ADVANCING TEXTILES THROUGH RESEARCH'.

"This convention, being sponsored by the three Southern Sections, is being held in the land noted for its hospitality and we hope that you will take this opportunity for relaxation and inspiration".

D. C. NEWMAN,
General Chairman.

Friday, October 22

9:30 A.M.—Registration.
9:30 A.M. to 2:00 P.M.—Personal Service.
9:30 A.M. to 12:30 P.M.—Technical Program (Two groups).
12.30 P.M.—Barbecue Picnic and Fish Fry.
2.30 P.M. to 5:30 P.M.—Technical Program (Two groups).
7:30 P.M.—Informal Dinner (Feature: General Research Committee Meeting).

Saturday, October 23

9:00 A.M.—Meeting Executive Committee on Research.
9:30 A.M.—Registration.
9:30 A.M. to 2:00 P.M.—Personnel Service.
9:30 A.M.—Intersectional Prize Paper Contest.
7:30 P.M.—Banquet.
Introduction of Guests.
Intersectional Contest Awards.
President's Address.
Guest Speaker.

Executive Committee and Chairmen

General Chairman
D. C. Newman
E. I. du Pont de Nemours & Co., Inc.
Charlotte, N. C.

Assistant General Chairman
J. A. Franklin
Augusta, Ga.

Banquet Chairman
Jack Anderson
Peerless Woolen Mills
Rossville, Georgia

Dining Chairman
J. L. Wyman
Nova Chemical Corporation
Augusta, Ga.

Entertainment Chairman
R. W. Philip
Callaway Mills Co.
LaGrange, Ga.

Entertainment Co-Chairman
P. G. Ware
Penick & Ford Ltd., Inc.
Atlanta, Ga.

Exhibits Chairman
Sherman A. Converse
Graniteville Company
Graniteville, S. C.

Finance Chairman
Charles A. Spratt
National Aniline Division
Allied Chemical & Dye Corp.
Chattanooga, Tenn.

Ladies Chairman
W. B. Griffin
Kali Mfg. Company
Atlanta, Ga.

Printing Chairman
Junius M. Smith
Textile Bulletin and The Knitter
Charlotte, N. C.

Publicity Chairman
A. R. Thompson
Ciba Company, Inc.
Charlotte, N. C.

Reservations Chairman
T. R. Smith
Wiscassett Mills Company
Albemarle, N. C.

D. C. NEWMAN
General Chairman

D. C. Newman was born at Woodstock, Va. about 51 years ago. After finishing grammar school and high school he went to Randolph-Macon College, Ashland, Va. where he graduated in 1917, majoring in chemistry.

His first position was with Federal Dyestuff and Chemical Company, Kingsport, Tenn. where he served in the Color Testing Department. After one and a half years he went with the du Pont Company, Organic Chemicals Department, Dyestuffs Division, and worked a number of years in their Technical Laboratory at Carney's Point, N. J. He was then associated with the Providence Office in a sales capacity for 4 years. From Providence he was transferred to the Charlotte Office in 1927 as Assistant Manager. He served in this capacity until 1943 at which time he was made manager of the Charlotte Office. In 1946 he became Sales Manager of the Southern District, including both the Charlotte and the Atlanta Offices, which position he holds at this time.

Mr. Newman is particularly interested in football, softball, tennis and other sports. He is married and has one son, Wallace B., who is now an employee of the du Pont Company.

He answers to the name of "Booney", which he recognizes more readily than the name "Douglas Cook Newman".

JEROME A. FRANKLIN
Assistant General Chairman

Jerome A. Franklin was born in Charlestown, S. C., in 1902 and was educated in the schools of Birmingham, Ala.

Mr. Franklin received his technical training in the laboratories of E. I. du Pont de Nemours & Co., Inc. and spent one year in finishing plants in New England, obtaining practical experience and information. After this he was in charge of the Gregg Division of the Graniteville Company when this plant started operations. Since 1926, he has represented the Organic Chemicals Department of the du Pont Company in the Augusta Ga. area.

Mr. Franklin is prominently connected with the Augusta National Golf Club, being a member of the Board of Governors of this club. He is highly interested in sports and particularly golf. At one time he was amateur city champion of Augusta.

Mr. Franklin is married, his wife being the former Miss Louise O'Downd, they having a family of two daughters and one son. The son, Peter Franklin, the oldest of the children, served during the recent World War in the Pacific area.

Make your plans now to attend the National Convention at Augusta on October 21-23

●

Auspices of Piedmont Southeastern and South Central Sections

Registration and Reception Chairman
A. K. Haynes
Rohm & Haas Co., Inc.
Atlanta, Ga.

Technical Program Chairman
V. B. Holland
Cannon Mills Company
Kannapolis, N. C.

Transportation Chairman
L. E. Whittelsey
Augusta Chemical Company
Augusta, Ga.

Sheraton Bon Air Hotel

Outing, South Central Section

THE summer outing of the South Central Section will be held on June 4th and 5th at the Whittle Springs Hotel, Knoxville, Tenn. A banquet will be held on Saturday evening at 7:30 P.M.

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Report, North Carolina State Student Chapter

A. T. HANES, Southern Manager of the Sandoz Chemical Works, was recently a guest of the North Carolina State College Student Chapter and exhibited a company movie entitled "The Metachrome Process". This showed mill practice and gave an instructive commentary on wool finishing and dyeing procedures.

After the film Mr. Hanes conducted a question and answer period in which many problems of the students were cleared up.

Respectfully submitted,

John R. Cramsie, *Secretary.*

Crockmeters and Crockmeter Cloth

Revised Prices

Regular Crockmeter	$20.00
Regular Crockmeter (with automatic counter)	30.00
Duplex Crockmeter	50.00
Crockmeter Squares (500)	1.50
Crockmeter Cloth (96 x 100), by the yard	.75

Available from the National Secretary:

Dr. H. C. Chapin
Lowell Textile Institute
Lowell, Mass.

NEW TEST FABRICS

New test fabrics are available from Werner Klaas of Testfabrics, 224 West 35th Street, New York 1, N. Y.

Of the two sponsored by the Association, one is similar to the old Multifiber Fabric, but of firmer construction, containing filling stripes of Wool, Viscose, Spun Silk, Bleached Cotton, Celanese Acetate, and Nylon, assembled in 2 inch strips, with a waste stripe between repeats, in fabric 38 inches wide, at present price of $4.00 per yard.

The second contains Acetate, Wool, and Bleached Cotton, so woven as to show on its surface one inch squares of Acetate and Wool and two inch squares of Cotton. This is 54 inches wide, and is for the present priced at $3.50 per yard.

CALENDAR

PHILADELPHIA SECTION
Meetings: September 24, November 12, January 28, 1949 (Kugler's, Philadelphia); Outing: June 11 (Atlantic City Country Club, Northfield, N. J.)

NEW YORK SECTION
Outing: June 25 (North Jersey Country Club).

PIEDMONT SECTION
Outing: June 18 and 19 (Ocean Forest Hotel, Myrtle Beach, S. C.).

NORTHERN NEW ENGLAND SECTION
Meetings: May 21, June 11 (Outing); September 24 (Andover Country Club); November 19.

SOUTHEASTERN SECTION
Meetings: July 24 (Atlanta, Ga.); September 25 (Columbus, Ga.); December 4 (Atlanta, Ga.).

SUB-COMMITTEES
Meeting: June 7 (Hotel New Yorker, New York).

COUNCIL
Meeting: June 8 (Hotel New Yorker, New York).

RESEARCH COMMITTEE
Meeting: June 8 (Hotel New Yorker, New York).

NATIONAL CONVENTION
October 21-23 (Sheraton Bon Air Hotel, Augusta, Ga.).

SOUTH CENTRAL SECTION
Outing: June 4 and 5 (Whittle Springs Hotel, Knoxville, Tenn.).

WESTERN NEW ENGLAND SECTION
Meeting: May 21 (Waverly Inn, Cheshire, Conn.).

EMPLOYMENT REGISTER

This column is open for four insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Textile Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers, who can obtain further information from the Secretary.

48-4

Education: Graduate, Philadelphia Textile Institute.

Experience: Testing dyes, etc.; chief chemist, in charge of mercerizing, bleaching and dye formulas.

Age 47; married; references; vicinity of Philadelphia preferred.

48-5

Education: B.T.C., Lowell Textile Institute.

Experience: Textile chemist and dyer, wool and cotton.

Age 40; married; references; will work anywhere in U. S.

48-6

Education: B.A. University of Pennsylvania, with graduate study.

Experience: Fifteen years, wool scouring, carbonizing, bleaching; synthesis of wetting agents, detergents, textile oils and sizes; shrink proofing, waterproofing, mildew proofing.

Age 36; married.

161st Council Meeting

THE Council held its 161st meeting in the Hotel Pennsylvania, New York, N. Y., on Friday morning, April 2, 1948. Present were President Henry F. Herrmann, presiding; John N. Dalton and C. Norris Rabold, Vice Presidents; William R. Moorhouse, Treasurer; J. Robert Bonnar, Chairman of the Research Committee; William O. Appel, William H. Cady, Carl Z. Draves, Louis A. Olney and P. J. Wood, Past Presidents; David X. Klein and G. Wendall Lever representing Northern New England; Arthur E. Hirst and Raymond W. Jacoby representing Rhode Island; George L. Baxter, Winn W. Chase, Charles W. Dorn, Emmett J. Driscoll, Herman E. Hager and William A. Holst representing New York; Arthur W. Etchells, M. H. Klein, Lloyd O. Koons and Percival Theel representing Philadelphia; Leland G. Atkins, Raphael E. Rupp and R. Hobart Souther representing Piedmont; C. Russell Gill representing Southeast; J. Albert Crumley representing South Central; Kenneth H. Barnard, Chairman of the Convention Committee; Patrick J. Kennedy, Chairman of the Intersectional Contest; Leonard S. Little, Chairman of President's Policy Committee; Harold W. Stiegler, Research Director; George H. Schuler of the Publicity Committee; J. Edward Lynn and Harold H. Taylor of the new Western New England Section; Frank E. Fleming, guest; and Harold C. Chapin, Secretary.

The Secretary's report of the 160th Council meeting and financial report of March 18, and the Treasurer's report of March 22, were accepted. George H. Schuler was appointed Vice Chairman of the Publicity Committee, in charge of technical publicity; and Dr. Simon Williams a member of the Technical Program Committee, replacing Dr. Walter J. Hamburger, resigned. The two Vice Presidents were added to the President's Policy Committee.

For the Research Committee Mr. Bonnar reported that work on the olive drab dyeing of cotton under supervision of the Lowell laboratory was completed, that a preliminary report had been approved by the Quartermaster Corps, and that the final report would probably be published. A special committee was considering the suggestion of a pilot plant for textile processing to be operated by the Association, and was assembling data both for and against. Arrangements were being made for new detergency machines containing improvements based on experiments with the first machine. Supplementing a fundamental study of the mechanism of dyeing planned by the Textile Research Institute, our Association had promised assistance in puting theories involved to practical test. Every proposed standard method of the Association is to be given more publicity hereafter, before adoption; and comments are invited from all members, addressed to the Chairman of the General Research Committee, the Research Director, or the chairman of the particular research committee concerned. Mr. Little reported a conference initiated by the Federal Trade Commission with view to specification of water repellency in the new CS-59-48 of the National Bureau of Standards. Further interest of the Federal Trade Commission in better specification of light and color fastness was cited by Mr. Dorn.

For the Corporate Membership Committee Mr. Driscoll reported new memberships and renewals bringing Corporate membership dues to approximately the figures of last year. A $14,000 increase is sought.

For the Colour Index Committee Dr. Olney reported progress of negotiations with the Society of Dyers and Colourists on division of editorial responsibility.

Because of increased costs, new prices were voted on the 1947-48 Year Book, as follows:

To non-members, United States and Canada, $5.00; elsewhere, $5.50.

To each member, one extra copy, U. S. and Canada, $4.00; elsewhere, $4.50.

To new members, one copy, U. S. and Canada, $3.00; elsewhere, $3.50.

As previously, each member receives without charge one copy for the year covered by his dues.

With approval of the Appropriations Committee, $1500 was appropriated for the expenses of a delegate to the International Textile Convention in England; and subsequent to the meeting, Mr. Bonnar was appointed the delegate.

For the Committee on Conventions Mr. Barnard reported invitations from the Rhode Island and Northern New England Sections for conventions in 1950 and 1952. These were referred back to the committee with power to authorize a convention in Boston on October 19 to 21, 1950, under such auspices as might be arranged with the Northern New England and Rhode Island Sections. Dr. Dahlen's committee was said to have the Augusta technical program eighty percent completed, with papers offered in excess of possible acceptance.

For the Intersectional Contest Committee Mr. Kennedy reported progress on contest papers for the Augusta meeting. Representatives of the three Southern Sections questioned the advisability of continuing this part of the program on a competitive basis in future years on the ground that it had served its original purpose of producing more convention papers, and that it involved discrimination between Sections rich in supply house laboratories with business interest in publication, as against Sections dependent on mill laboratories with primary interest in protecting private information.

The proposal, in January, of an anonymous survey, by questionnaire, of group relations between salaries and such other factors as nature of work, age, experience, education and geographical location, was further described by David X. Klein. It was opposed on the ground that it would be offensive to certain of our members, and that ability and experience would be difficult to state in such exact terms as educational attainment. A motion for further consideration by a commiteee was defeated.

For the Committee on Membership and Local Sections Mr. Rabold reported the credentials of the proposed Pacific Coast Section and Bradford Durfee Technical Institute Student Chapter. Both were approved, and H. A. DesMarais was appointed Secretary pro tem of the Pacific Coast Section, to include the states of Washington, Oregon, California, Idaho, Utah, Arizona, Nevada, Colorado, New Mexico and Western Texas.

Informal suggestions from Association members in Montreal, that the Council and

SECRETARY'S FINANCIAL REPORT—MARCH 18, 1948

	Applications	*Dues, regular & reinstate*	*Dues, Corporate & Sustaining*	*Miscellaneous*	*Totals*
Received and transmitted to Treasurer,					
August 1 to Dec. 31, 1947....	$1,686.50	$25,982.50	$22,005.00	$17,914.47	$67,588.47
Dec. 31, 1947 to Mar. 18, 1948..	1,368.00	6,278.50	12,260.00	6,886.72*	26,793.22
Total in fiscal year to date.....	3,054.50	32,261.00	34,265.00	24,801.19	94,381.69
Leaving deposited by Treasurer with Secretary, general					20,000.00
Leaving deposited by Treasurer with Secretary, for salaries and miscellaneous payments					7,457.25

*Miscellaneous items	
Dividends	$178.20
Quartermaster contract	3,844.67
Chicago convention profits	500.00
Reporters and reprints	25.85
Year books	479.09
Analytical Methods	3.00
Crockmeters	550.00
Crock cloth	264.50
Moth cloth	70.00
Water test apparatus	8.75
Dyed standards	40.00
Knitted tubing	30.75
Gas fading units	58.00
Buttons	14.00
Color transfer charts	38.00
Colour Index	196.00
Royalties, multifiber cloth	588.10
	$6,888.91
Less bank charges	— -2.19
	$6,886.72

Research Committee meet in that city, were received with interest; nearly half of those present signifying that they would attend such a meeting. Favorable response was reported from the afternoon Research Committee meeting.

To avoid Section outings, and at the same time give consideration to the Textile Exhibition in New York, it was voted that the date of the next Council meeting, already planned for the second week of June in that city, be changed to Tuesday, June 8.

To Corporate membership were elected the Bates Manufacturing Co., Merchants Products Corporation, and Orleans Company, Inc. Each of the following was elected to the class of membership specified, as of thirty days from publication of application, provided no objection be received meanwhile by the Secretary.

Senior

G. B. F. Adam
E. H. Aeckerle
A. M. Allen
P. A. Arsenault
L. D. Barrick
L. C. Batdorf
H. W. Beck
J. W. Billingsley
R. P. S. Black
R. B. Blodgett
J. V. Boone
F. J. Britz
E. E. Burgner, Jr.
L. A. Burroughs
R. C. Carr
J. H. Cochran
E. C. Coker
I. Colbert
F. B. Cooper
E. T. Corbitt
J. L. Costello
L. T. Crews
J. M. De La Barre
J. E. Dempsey
W. R. Derr
G. H. Dockray
T. C. Drew
O. Edelstein
T. M. Egger
A. E. Elias
C. Ergin
J. M. Evans
R. K. Federal
J. G. Ferguson
C. B. Fletcher
J. C. Fonville
J. P. Franklin
F. M. Gardiner
N. J. Glade
C. P. Gordon, Jr.
J. Gould
D. H. Hahnenstein
C. H. Heinen
W. A. Hilbert
A. B. Hilton
R. Howarth
R. M. Hoyt
M. Johnson
B. P. Jones
C. H. Karnes
R. H. Keating, Sr.
W. T. Kennedy
R. J. Kerr-Muir
K. B. King
J. F. Laferry
J. Lalinde
H. Landfield
G. F. Langhirt
A. Leitstein
R. M. Lesh
E. Lurie
B. Menin
R. B. Miller
J. C. Moessinger
A. M. S. Murray
C. J. Naegele
S. J. Nanasy
A. S. Nyquist
J. F. Oliver
J. W. Patterson
W. J. Patterson, Jr.
P. A. Peirce
N. J. Perna
J. B. Phillips
R. H. Phillips
T. A. Pickup
M. M. Pollard
R. F. Pollard
G. D. Pratt
G. N. Reed
E. W. Ricci
D. V. Richardson
M. I. Rollins
R. J. Ross
H. J. Salese
W. E. H. Searcy III
T. P. Seney
F. C. Sertl
J. C. Sherrill
N. E. Shohet
J. A. Simmons
P. H. Slaughter
W. G. Sloan
E. E. Smythe
C. U. Stevens
E. J. Takach
J. C. Thissen, Jr.
W. F. Thompson
J. F. Thomlinson
E. J. Troianella
W. A. Turner
R. H. Tuttle
S. A. Velez
J. A. Verhage
E. A. Vitalis
C. G. Vogt
N. A. Whiffen
H. E. Whittle
A. G. Willard
G. B. Willgeroth
P. B. Willgeroth
F. H. Winter
A. R. Williams
C. F. Wittichen, Jr.
M. R. Woodard
H. H. Zweifel
C. A. Young
J. A. Zelek
D. A. Zink

Junior

R. P. Anthony
W. L. Aston
H. C. Barry
W. V. Bagley
W. M. Bonner
E. M. Burass, Jr.
J. A. Darsey
R. M. Johnson
M. P. Kearns
M. K. Krape
K. A. Lokapur
B. J. Manchester
B. S. Manton
H. W. McNulty
H. J. Menger
C. R. Neal
R. E. Nickerson
P. W. Oppenheimer
J. H. Propst, Jr.
C. Serano
F. B. Shippee
H. C. Simonson
K. G. W. Smith
A. C. Sutherland
J. J. Schweitzer
J. M. Welch
R. S. Warton
S. P. Young

Associate

R. B. Anthony
I. D. Arnold
P. M. Benjamin
B. Blickman
C. W. Bowden, Jr.
B. F. Braun
I. D. Brown
C. A. Burckhardt
R. L. Burnett
F. J. Chadwick
J. M. Duckett
M. Frankel
H. K. Goerner
F. E. Hilger
W. E. Howell
Y. L. Lee
D. C. Legendre
F. Lofti
M. K. McClennan
C. P. McDonald
V. S. Mehta
A. E. Mitchell
G. Pieroni
J. W. Romine
H. M. Rose
T. Schetty
W. H. Schreiber
A. M. Siegel
F. A. Sloop
F. Thrane
J. P. Thurman

Student

S. M. Billett
C. E. Blossom
M. B. Corl
S. Derner
J. H. Ellis, Jr.
W. E. Fayssoux
C. G. Fleisher
D. A. Gardner
J. H. Holmes
T. T. Howe
R. C. Hurt
G. A. Jeandros
J. L. Jerome
H. S. Kalpakgian
A. G. Kidder
K. E. King
T. J. Latham
K. T. Layfield
E. J. Lukas
J. L. Maltese
C. H. McGill
J. Moss
R. Murray
J. R. Nisbet
O. A. Ofjord
J. M. O'Flahavan
F. R. Paoula
H. A. Pippy
A. M. Purut
G. V. Raso
R. A. Fivadeneyra
E. Rivollier, Jr.
R. S. Sappington
C. M. Sappington
C. M. Stewart
J. R. Stilwell
R. A. Stowe
E. W. Teague
O. I. Torfilli
W. F. Wigglesworth

Transferred from other classifications to Senior membership were F. H. Bell, G. R. Boule, R. L. Bullock, B. E. Dodd, E. S. Lamont, J. Linton, III, R. MacDonald, F. W. Mitchell, H. R. Schroeder, E. M. Taylor, J. Toledo, R. E. Willett.

Respectfully submitted,

H. C. Chapin, *Secretary.*

Textile Drying*

MYRON T. FLEMING

Sales and Development Engineer, Proctor & Schwartz, Inc.

Part One
THEORETICAL CONSIDERATIONS

I WANT to cover three aspects in the general field of textile drying. First, I want to discuss briefly some of the theoretical considerations involved. Next, we will examine some of the practical problems, and last I would like to look at the future trends and discuss the need for extremely close cooperation between mill operating men and machinery manufacturers.

As some of you may know, I am connected with a large machinery manufacturing concern dealing with a great variety of industries and specializing largely in drying and allied processing equipment. If we were to group all textile equipment under one head, this would constitute some 40% of our total volume; so you can readily understand our active interest in this field.

In discussing some of the theoretical questions, my purpose is not to confound you with the extent of our profound knowledge on this subject or to sprinkle formulae and differential equations around to build up personal prestige. Rather it is to discuss these questions from a common sense viewpoint, so that as mill operating men, you can possibly be aided in some practical problem. Despite some of the mystery surrounding the operation of some dryers, as when the operator says, "Hey Joe, don't open that window, this blasted machine won't dry with that open", they really do operate in accordance with sound scientific laws.

Basic Drying Curves

Fig. 1 shows the theoretical curve that you might have been exposed to in some chemical engineering course, and shows the classical constant rate of evaporation as well as the so called falling rate period. This merely says that at or above certain moisture contents, water is evaporated at a constant rate, while below this point water is evaporated at a variable rate depending upon the diffusion characteristics of the material.

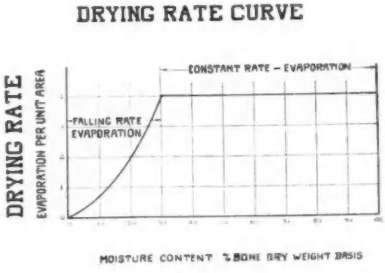

Fig. 1

The evaporation rate for the first portion is effected by air temperature, air humidity, air velocity, method of air circulation and certain material characteristics to be discussed briefly later. From a practical standpoint, this is the portion of the drying curve usually dealt with in textile drying. The falling rate curve is more frequently encountered in heavy chemical drying, and is a mathematician's delight of involved equations dealing with capilliary action, porosity, material constants, etc. Fortunately in this discussion we need not concern ourselves with this part of the curve.

As such this curve is not in particularly good form for practical use and we generally use the type of curve given in Fig. 2

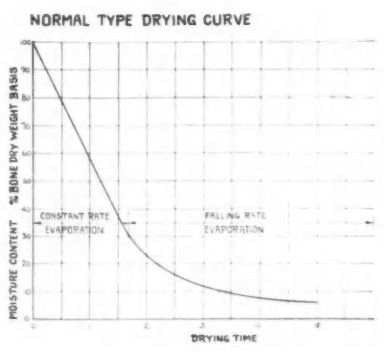

Fig. 2

which shows a curve of moisture content plotted against drying time. You will notice that there is a straight portion down to approximately 30% moisture content, and from this point on, a curved line denotes a falling rate of evaporation. However, this does not correspond exactly to the standard falling rate laws, and is in part due to individual fibers being dryed to their equilibrium point. For all practical purposes, in dealing with any textile drying where there is intimate contact between the drying medium and the individual thread or fiber, the variation in drying time with different drying conditions follows the laws governing the variation of evaporation rate during the so called constant rate period of free evaporation. Of course this does not apply in the cases where there is thickness to the object to be dried such as in package drying. It will be of some interest to look briefly at a curve of this type as shown in Fig. 3. This shows a drying curve broken by a changing temperature schedule. In this case the drying rate is deliberately retarded to the diffusion rate, in order to prevent over drying of the surface. It is of interest to analyze this curve on the basis of a curve showing evaporation rates. This is shown in Fig. 4 and shows the effect of changing the humidity even in the face of a lowered dry bulb temperature. There is considerable room for discussion of this particular drying problem but time is not available here. However, it is of interest to

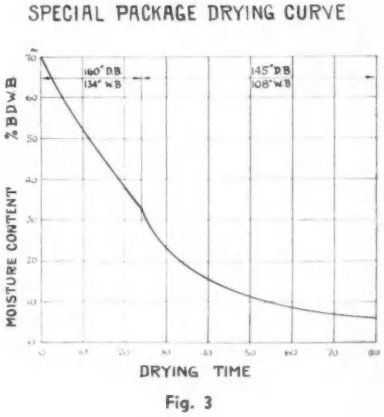

Fig. 3

* Presented at meeting, New York Section, January 23, 1948.

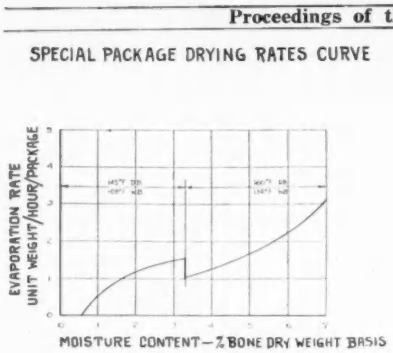

Fig. 4

note that in this drying application there is no constant rate period.

The average curve is not as involved and is shown in Fig. 5. This follows the laws of free evaporation in which fibers or threads make intimate contact with the drying medium. Here is the practical curve of moisture content plotted against drying time, which gives the material constant and basically determines the proper dryer design.

Factors Affecting Drying Rates

Now that we have examined a drying curve under one set of drying conditions, let us look at the factors that influence this curve, the drying time, and therefore the size of machine for the required capacity.

First, drying is essentially a problem in heat transfer. When water is evaporated, heat must be supplied at the rate of approximately 1,000 BTU per pound of water evaporated. In addition, heat must be supplied for the heating of material, necessary fresh air and other losses. Basically this heat can be supplied by conduction (contact), convection (air flow), or radiation (sunlight), as shown graphically in Fig. 6. In Fig. 7 we have shown three familiar textile applications in which heat transfer and therefore drying is accomplished by each of these methods.

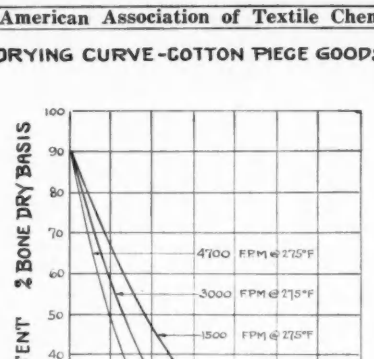
DRYING CURVE-COTTON PIECE GOODS
MOISTURE CONTENT % BONE DRY BASIS
4700 FPM @ 275°F
3000 FPM @ 275°F
1500 FPM @ 275°F
DRYING TIME — SECONDS

Fig. 5

To sum this up briefly, the idea we must get is that to evaporate a pound of water a certain amount of heat must be supplied by the above methods separately or in combination. If we remember this single fact, our subsequent discussion of drying by radiant energy will become quite simple.

Temperature and Humidity

Now that we understand heat transfer problems in drying, let us look at the effect of temperature and humidity on drying time. Fig. 8 sets up a simple drying condition, and shows the basic reason for evaporation once equilibrium conditions have been established. Without going into detail, water vapor exists in the air at a certain vapor pressure. Likewise, heat is supplied to cause the material or water in the material to reach the wet bulb temperature or slightly higher, and this water has a certain vapor pressure corresponding to its temperature. Now the only way water can evaporate from the material is for the vapor pressure of the water to exceed the vapor pressure in the air. Therefore, the vapor pressure difference is actually the drying potential. Let us therefore check the conditions given in Fig. 8.

Here we have 200° F. dry bulb and 110° F. wet bulb which results in a vapor pressure of 1.72 in. Hg. The water temperature is 110° F. and its vapor pressure 2.60 in. Hg., which gives a pressure difference of 0.88 in. Hg.

Now let's change this to a higher temperature condition while maintaining the same absolute humidity. In Fig. 8, Condition B., we have 300° F. dry bulb and 120° F. wet bulb with resulting vapor pressure of 1.72 in. Hg. The water temperature of 120° F. results in a vapor pressure of 3.45 in. Hg. and a pressure difference of 1.73 in. Hg.

Comparing the resulting pressure differences we could anticipate an increase in drying rate of 1.73/0.88 or 96.5%. In practice this may vary and it is necessary for us to collect a series of modifying constants dependent upon material, practical increase in absolute humidity, and other factors. However, it is a sound basic fact and is something that you can depend upon as a reliable guide.

Air Velocity

Another factor that is of extreme importance is air velocity. From our short investigation of heat transfer we found that evaporation required heat, which in turn had to be supplied by one of three methods. In hot air drying this is supplied by air, and it is only common sense to expect a higher velocity of air past a drying surface to give accelerated heat transfer and hence an increased rate of evaporation. This is borne out theoretically and by practical test results. The drying time is a function of velocity, and depending upon a number of conditions, will vary inversely as from the 0.5 to the 0.8 power of the velocity. In other words, if we double the air velocity we cut the drying time almost in half. Of course,

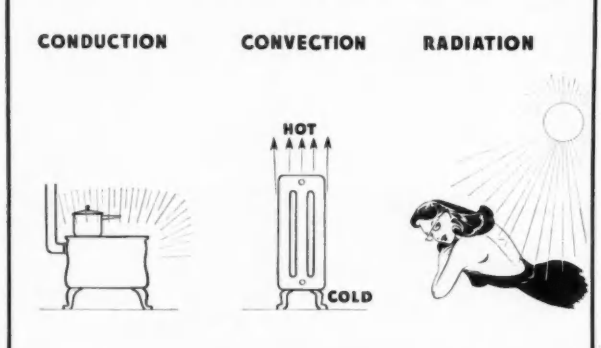

Fig. 6

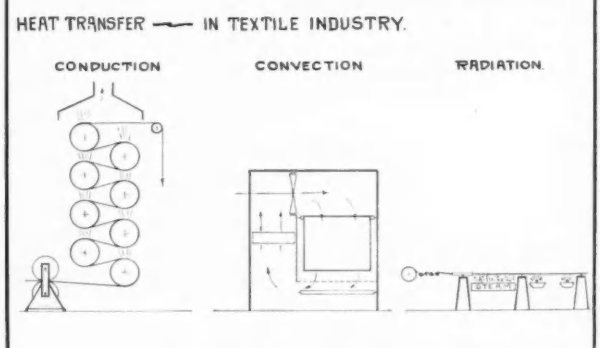

Fig. 7

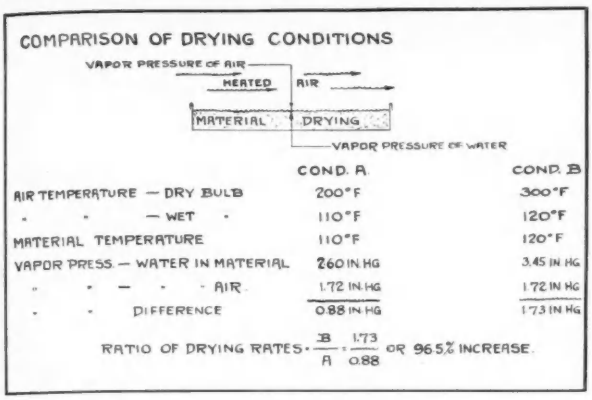
COMPARISON OF DRYING CONDITIONS
VAPOR PRESSURE OF AIR
HEATED AIR
MATERIAL DRYING
VAPOR PRESSURE OF WATER
COND. A
COND. B
AIR TEMPERATURE — DRY BULB 200°F 300°F
" " — WET " 110°F 120°F
MATERIAL TEMPERATURE 110°F 120°F
VAPOR PRESS. — WATER IN MATERIAL 2.60 IN HG 3.45 IN HG
" " — " — AIR 1.72 IN HG 1.72 IN HG
" " DIFFERENCE 0.88 IN HG 1.73 IN HG
RATIO OF DRYING RATES = B/A = 1.73/0.88 OR 96.5% INCREASE.

Fig. 8

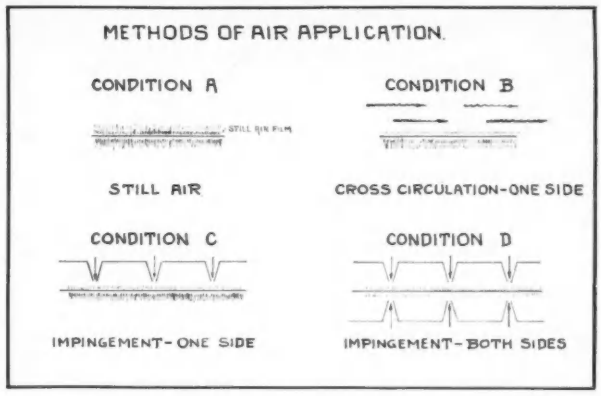

Fig. 9

here again, this must be used as a guide only. We have compiled over the years a mass of actual test data with which we can modify computations from these basic laws.

Method of Air Application

The laws just discussed give variation in drying rate for a given set of conditions as regards method of air application. Let us now look at the different methods of air application and their effect upon the evaporation rate. Fig. 9 shows several methods of air circulation, and a shaded area which designates a still air film acting as a retardant in all heat transfer action. Notice that in (b) cross circulation, one side has a comparatively small film thickness, so that there is less resistance to the heat flow required for evaporation and hence greater evaporation than in the case of still air as shown in (a). Direct impingement one side is still better as shown in (c), and direct impingement on both sides the best condition as shown in (d).

Material Factors

And now that everything is well ordered and we have a lot of confidence in these good sound laws, here comes confusion when we run head on into the actual material. You have all encountered this feature time and time again in your own plants. We are forced to conduct laboratory tests, and indeed we do this far more than is commonly realized in the textile industry. This procedure is one of common practice in the heavy chemical industry, and is increasingly indicated in the textile industry with the number of specialized processes coming into the picture. In any case, to simply mention a few variables we encounter in textile drying, we have the material, fiber thickness, thread count, twist, cloth construction, dye, finishes or sizes used, porosity, etc. All of these influence drying curves, evaporation rates, and explain why in the present state of scientific knowledge it is still impossible to calculate evaporation rate and drying times by means of mathematical formulae.

Therefore, when you are asked by any machine producer for samples of your material for the purpose of making tests, this is not the fruit of ignorance, idle curiosity or the desire to get the "little woman" some free dress material. Rather it is a desire to insure the fact that a definite piece of equipment will do the job in your individual mill and on your particular fabric. Indeed in many cases you should insist on this procedure!

Special Drying Applications

At this point we come naturally to two special methods of drying that have received much glamourous publicity as being a "royal road to romance" in drying. Many of you have experience with either one or the other. These are drying by infra-red radiation and drying by the passage of a high frequency current through the material. I want to discuss each method briefly and simply.

Infra-Red Radiation

Infra-red radiation is a form of wave energy emanating from a heated surface. Its source can be electricity in which the radiating element is the filament, a refractory gas burner in which the radiation elements are the frame and refractory arch, or a plain heated surface. The energy radiated and hence the heat available for use in drying is proportioned to the fourth power of the absolute temperatures expressed in degrees Kelvin. Therefore, while some energy transfer will occur from a surface at 100° C. (373° K.) to a surface at say 60° C. (333° K.), almost 100 times that amount will occur from a surface at 600° C. (873° K.).

When the wave of interest in this possible drying method first came, there was thought to be some appreciable penetration possible by this energy. From our investigation, which was first by the way back in 1938, we disproved this to our satisfaction and concluded that there was at the most only such skin penetration as might occur in the drying of paints or lacquers. The basic theory of wave radiation supports this lack of penetration and had we found anything different, we would have been most surprised. This does not, however, immediately disqualify this for all textile problems, and many applications are in actual use today.

Now for a moment let us look at the economics of this type of drying. If we must have 1000 BTU's to evaporate a pound of water we can compute what this means basically from various sources of supply. Starting with electricity, at an average price of 1¢ per KW-hr. which is equivalent to 3412 BTU's, we find that radiation drying, based on 50% efficiency in conversion, costs:

$$\frac{1000}{3412} \times \frac{0.010}{0.50} = \$.0060$$

Now gas at 500 BTU's/cu. ft. with an average cost of 0.60/1000 cu. ft. gives:

$$\frac{1000}{500000} \times \frac{0.60}{0.50} = \$.0024$$

Taking steam at 50¢ per 1000# at 80# pressure, and 80% efficiency of conversion, we have:

$$\frac{1000}{1000 \times 890 \text{ BTU/\# steam}} \times \frac{0.50}{0.80} = \$.0007$$

Looking at this comparison, you can see that electricity is approximately 8 times as expensive as steam, while gas is 4.0 times as expensive. This, of course, will vary in specific cases and in given specific designs.

Please don't misunderstand me! Even these figures do not throw this out as a booster operation or where heat requirements are small. Let us therefore investigate radiant drying in this particular application.

These installations have been most successfully used to obtain a pre-drying in front of existing machines. In some of these installations there have been increases in output of as much as 20%. But now one more word of caution! If you have an installation like this which gives you a certain increase on one machine, don't expect to put this on a different machine and get the same in-

crease. The reason is simply this. A definite set-up has the ability to transfer a certain constant amount of heat to the material being dried. If this same installation is moved from a machine running at 30 yards per minute to a machine running 60 per minute, we should not expect the same percentage increase in capacity.

Probably the definite increase in yards per minute would remain the same, and therefore your percentage increase would drop from 20% to 10%. Here in a word, is the reason for not generally offering new equipment with this type of operation. It has so far been far more satisfactory to obtain increased capacity by the use of higher air velocities, better application of air, better temperature distribution, etc.

Let us then sum this up. Drying by radiant heat methods, call this infra-red if you wish, has a very definite speciality application particularly in booster type of operation, and each case should be analyzed from a common sense engineering standpoint. There are some limitations in this use that should be mentioned in a summary. 1) It is more expensive. 2) Special automatic devices must be used to prevent scorching of material when slowing down or stopping. 3) Lamps if used should be shielded from possible contact with water, or they will break violently causing several others in the vicinity to break. 4) The equipment should be enclosed and some provision made to remove water vapor for best results.

High Frequency Drying

The second method, namely high frequency drying, is purely electrical, and while still in the development stage with severe limitations for practical commercial use, it gives genuine future promise in certain applications where there is compact thickness to the material to be dried. Our work extends back to 1938 when we sponsored graduate study in this field at the University of Cincinnati. It may surprise many of you to know that we have an appreciable number of these installations in service and have some very definite results.

Essentially, this equipment consists of a drying chamber which must have a definite air circulation and be capable of having the air temperature controlled. Exhaust must be provided as in a conventional dryer to remove the proper amount of moisture laden air. Added to this are two electrodes of one type or another between which the material to be dried must pass. The passage of high frequency electric current (between 12 and 30 megacycles) generates throughout the material a certain temperature which speeds migration of the water from the interior of the material to the surface, where it must be removed by the air circulation. Aside from the practical design, which has a number of interesting points, there are to date a number of limitations in the use of this equipment that can be discussed here.

First, we have previously seen a basic comparison between electricity and steam as a source of heat. Now high frequency generating units have varying basic generation efficiencies, but let us take a fair figure of 50%, which in an installation of this type makes the cost of drying between 15 and 20 times as expensive as steam. However, the drying problems in some materials are so severe that the cost does not necessarily eliminate this drying method. These are, of course, very special cases.

Another limitation still is the positiveness of control at true high frequencies. This is essentially a simplified radio transmitter with resonance circuits in which the material being dried is part of the circuit. With change in moisture content the characteristics of this circuit can change and high discharges occur, resulting in hot needle like burns in the material. However, our knowledge is improving all the time, and this does not appear insurmountable.

The third limitation is the cost of replacing expensive power tubes. This is a definite item and can be pro-rated to hours of operation, since some tube manufacturing companies will sell a definite service to maintain tubes at a fixed cost per hour.

It is of interest to look at the size of installation that might be involved in commercial operation. It is not unusual to figure on an evaporation of 2000 pounds of water per hour. This in an over-all installation would probably require 2000 pounds of water $\times$ 1000 BTU's $\times$ 1.20 (allowance for additional heat losses) 2,400.000 BTU/hr. or

$$\frac{2{,}400.000 \text{ BTU/hr.}}{3412 \text{ BTU}} = 700 \text{ KW-hr.}$$

Allowing 45% efficiency this means 700/0.45 or a power input of 1550 KW which, of course, is a sizeable power demand and one that will require special installation.

Mechanically this corresponds to

$$\frac{1550 \text{ KW}}{0.746} = \text{over 2000 HP.}$$

I believe we can summarize this by saying that high frequency drying has a definite future in speciality drying and heating, but even in this type of installation practical commercial operation with normal capacities seems some years in the future.

As a general summarization, I believe that from any objective study of both radiant and high frequency drying, we can say that steam and hot air drying will be used for the vast majority of drying applications for many years to come. At the same time, we are continuously working in both of these fields, since they are definitely a part of this entire drying picture and with future developments will undoubtedly come into more general use.

Methods of Obtaining High Temperatures

Before we leave the theoretical side of drying there is one subject that should be discussed. With the increasing use of resins and high temperatures required for curing, some attention should be given to methods of obtaining this. Fig. 10 shows the cross-section of a dryer that has a curing temperature of 350° F. Temperatures throughout the air circuit of this machine are shown. Now suppose we consider what is involved in obtaining this temperature with first 60#, then 110# steam pressure. Notice that in 60# steam no heat can be added by this steam temperature of 307° F. The air temperature should never drop this low, and of course it is a basic law that heat must flow from a point of higher temperature to a point of lower temperature. Indeed in this application heat could actually be added to the steam causing super heat. In the case of 110 pound steam with a steam temperature of 344° F. some heat can be added, but it is not possible to reach the desired curing

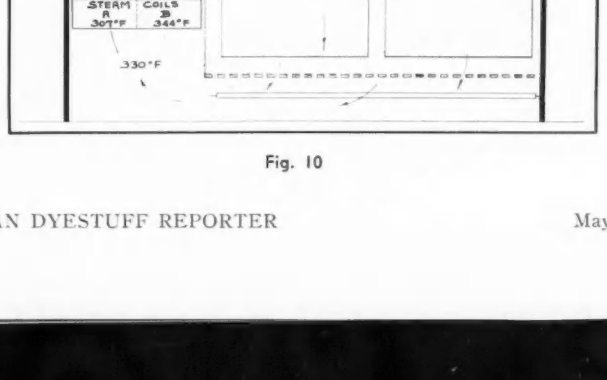

Fig. 10

temperature. Obviously to steal a phrase from the tobacco people, "something new must be added" in each case.

One of the obvious additions is direct fired gas equipment or electric booster coils. In the case of 60 pound steam, the steam coils can add nothing in the way of heat transfer, and are in most cases eliminated. In the case of 110 pound steam we can secure an appreciable amount of heat, and the additional equipment required can be installed in a booster position. In this event we have a condition shown in B, Fig. 10. One word of caution in the indiscriminate use of gas burning equipment. Contrary to common opinion, air does not mix rapidly, and it is possible to have stratified layers at different temperatures unless careful attention be given to this point. I simply mention this for what it is worth, because I have had some rather peculiar reports that could be explained by this erratic mixing. Of course with this condition some misleading curing requirements would be established.

There are other methods of obtaining high temperatures that are less generally in use. Steam pressure can be raised by means of a steam booster compressor to the desired curing temperature. In the case above, this would require a final steam pressure of approximately 185 pounds P.S.I.G. In this compressor the final condition of the steam carries some super heat, which however is no advantage.

Another method is the use of indirect oil fired equipment, in which you have an external oil burner of sufficient capacity and circulate the products of combustion through a special air heat exchanger. This becomes rather involved, although we have used this in special installations, not as yet in the textile industry.

Part Two

PRACTICAL CONSIDERATIONS

Practical Dryer Design

With this brief discussion of basic drying theory, let us now look at some of the practical considerations involved in textile dryer design.

As we consider these questions I want to develop them from the standpoint of three people; first, the man responsible for final quality, be he chemist, dyer or finisher; second, the man responsible for producing so many yards or pounds of material per week; and third, the poor designer of machinery who must satisfy these first two people and at the same time deliver a sound, cleanly designed machine.

Material Requirements

Suppose we take first the man responsible for quality. If he is in the textile business you would be safe in saying that he is concerned with tension. This comes up in many ways and means different things. In the drying of pot spun rayon cakes proper tension control means evenness of color absorption, and general processing as the material moves toward the finished fabric. In flat woven piece goods it may mean improved hand and launderability, low residual shrinkage, better crush resistance, and improved finish generally.

His next problem may be the elimination of finish marks due to creases or uneven drying after finish application. Previously this was one of the bug bears of loop drying, and the insistence and vigilance of the varyous dyers and finishers dictated the development of specially covered, rotating girts, precision air looping devices, and controlled air circulation in the modern loop dryer, that have almost completely solved this problem. So you see we are keenly interested in this quality conscious gentleman.

Another problem he may be concerned with is color or resin migration. Considerable attention has been directed to this by the increased use of pigment pad dyeing and resin application. The mechanics of this are rather simple. A pigment or resin is carried by a fluid, in solution or suspension. If drying is from one side of the fabric it is reasonable to expect a certain flow to this maximum point of evaporation, and therefore more deposit of pigment or resin at this point. In the case of color migration the problem can be attacked from a chemical standpoint, in which a retardant to this capillary flow is added, and/or from a design standpoint in which drying is carefully balanced to eliminate this tendency. In the case of resin application certain resins exhibit this tendency to a greater extent than others, but here again careful attention should be given to carefully balanced drying.

This critical gentleman has another interest in how he wants his material handled. If it be piece goods it may be a question of folding into trucks or batching on rolls, and if it is batching on rolls he may have very definite ideas on the tension allowable. In skeins it may involve the question of tangling or splitting delicate yarns. In package drying it may be special protection against dirt that dictates the drying method. In tubular or flat knit it may be a question of preparatory handling to effect a proper entrance to the drying machine.

And of course, generally this gentleman has a very good idea how he wants his material dried to achieve the results in mind. To put it simply, he does not generally expect to dry cotton sheeting on a loop dryer, nor does he expect to dry a soft spun rayon on a stack of dry cans.

These are only a few of the things that are turning over in the mind of this busy gentleman, but he knows with certainty that close attention to these details means improved quality and increased sales.

Production Requirements

Now we turn to the second individual, who is responsible for overall plant production. He has every sympathy with his predecessor but he must get total weight or yardage out each week. First he wants maximum production per unit floor space with maximum efficiency. Therefore he probably insists, wherever possible, on two strand operation. I think as a basic principle most mills are committed to this, but it is amazing how often multiple strand machines are found running with one strand of material.

This driving fellow now must decide another question. Is a certain process to be batch, as in truck dryer, or continuous, as in a conveyor type dryer? This usually comes up in yarn processing, and must be analyzed from the standpoint of total production, lot size, space available, etc. The main advantage in batch operation is a certin flexibility in handling various lots having different characteristics. Its disadvantages are low production per unit of floor space, heavy truck handling, truck space required, and the difficulty of utilizing labor efficiency. A continuous (conveyor) system is machine paced, and total production can be controlled more easily.

The next question before this Plant Superintendent is one brought to prominence by the development of various continuous processes such as continuous bleach, continuous vat dyeing, and the general trend toward combination processing such as resin pad, dry, cure and wash. This is the question of range operation; how far to go, where to break, and what flexibility to insist upon. This, of course is a discussion in itself, but let us look at it briefly. The main attraction is of course the possibility of increased production efficiency coupled with closer control. Opposing this is the loss in flexibility, the requirement for higher standards of operation and maintenance. Let's bring this out another way. If a range consisting of five elements is stopped for either normal operating causes or for maintenance, the production from four other machines automatically stops. The economics however are simple. A machine added in range with saving of $5,000 per shift per year can justify expenditure of $15,000 under almost any type of purchasing control.

With his brother-in-arms responsible for quality, this production man is interested also in methods of material handling. Generally a plant makes one of two decisions,

either to handle all materials possible folded in trucks, or to handle all materials possible batched on rolls. In either case it is increasingly evident, with the high speed machines of today, that it is necessary to give close attention to the elimination of stops between rolls or trucks. For example, a machine running a 80 yards per minute can lose considerable production if it is necessary to lose one minute every time a 400 yard roll is changed. This would mean that one minute out of every six is wasted, and a drop in production of nearly 17% would result from this cause alone.

Machine Design Requirements

Now that we have looked at the mill requirements, let us look at the poor fellow who must satisfy these men and yet build a strong, cleanly designed machine that can stand the severest kind of plant operation.

He must design for efficient operation from the standpoint of power consumption and from the standpoint of the machine operator. He conducts a never-ending search for better insulation, better heat transfer design, more efficient fans, better air application, and in an increased number of cases more corrosion resistant materials of construction. He must design a machine that is simple and easy to operate and as nearly foolproof as possible.

He must constantly improve the general cleanliness of his design. By that I mean the elimination of drives, shafts and other extraneous material that are simply stuck on a machine. Whenever possible these should be built in the machine. The other part of this subject is the cleanliness of the interior. Here he must give attention to the elimination of pockets, sharp projections, etc., that tend to collect air borne lint, etc.

With these conditions to be satisfied, he also must turn out a machine that will stand 24 hours a day of mill operation, not only this year and next, but perhaps 20 years from now. To do this he has all the problems of the structural engineer combined with the problems of vibration and moving loads.

But we don't want to sympathize too much with this gentleman or he may stagnate. Your job is to give us your requirements, and our job is to fulfill them and satisfy as well our self-imposed standards of engineering design.

Let us look at a few machines and see how different conditions are satisfied.

Fig. 11 shows the Impact type of dryer for Raw Stock. Here is one answer in the stock drying field to the demand for absence of fiber disturbance, uniformity of drying and maximum production. From the machine designer's point of view this was accomplished by the use of a better method of air application, a better heat transfer design and the use of a more efficient fan at a higher static pressure.

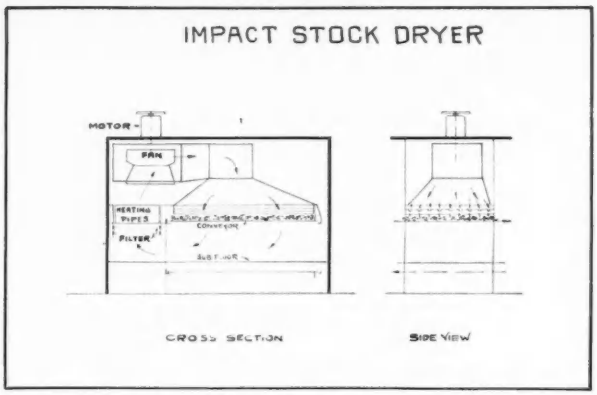

Fig. 11

Fig. 12 shows a conveyor type of continuous bleach system for open width cotton piece goods. Here the industry demanded a continuous bleaching system that would provide close control, be adaptable to varying widths of cloth, and allow the fabric to be handled at full widths. At the same time this machine had to be steam tight and provide resistance to the action of caustic and peroxide. The designer's answer came from prior experience in building a heavy duty conveying system for the chemical industry capable of being constructed entirely of corrosion resistant metals.

Fig. 13 shows a modern loop dryer where the critical demands of the industry have produced a machine entirely of structural steel, with specially covered rotating girts, a special air looping device, adjustable air circulation, occasionally two speed motors; capable of operation at any drying or curing temperature.

Fig. 14 shows a suction cylinder dryer developed for the handling of warp knit fabrics in a relaxed condition, which seems to have some potential for the drying of tubular knit and certain critical woven fabrics. Here is a design answer which must still be investigated to realize its full possibilities.

Fig. 15 shows the overfed pin tenter, another machine developed at the dictates of a class of fabrics and finishes that requires high speed, and relaxed drying with controlled residual shrinkage. Here the designer was confronted with a problem of accurately overfeeding, guiding, and pinning on fabrics within a tolerance of 1/16" at speeds up to 100 yards per minute.

So you see from these brief examples how machines are born and grow. They do not just spring into existence and grow like Topsy; they are conceived in the critical demands of the industry and born through the

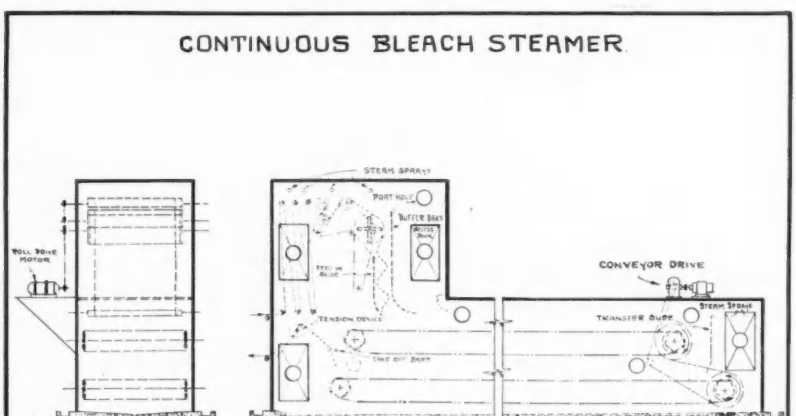

Fig. 12

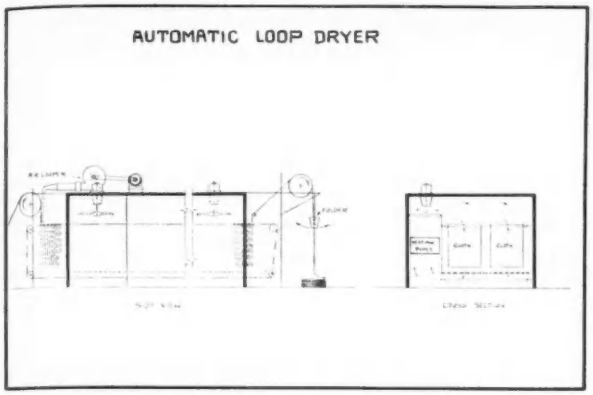

Fig. 13

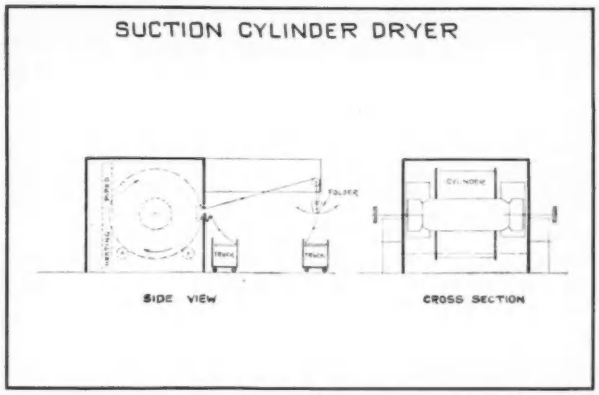

Fig. 14

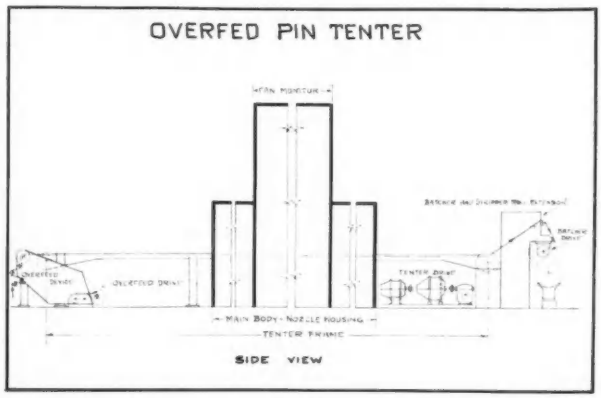

Fig. 15

combined efforts of the producing mills and machinery manufacturers. How well they grow depends largely upon the soundness of the conception and the care and cooperation given the development prior to and after initial operation.

Part Three
FUTURE TRENDS AND NEED FOR COOPERATION

And now that we have covered the subject of drying to this extent, it would not be complete if we did not look a bit into the future, and stress again the essential need for mill men and machinery men to live closer and closer together.

Increased Production Efficiency

First I believe we can expect more and more pressure for increased production efficiency. This will come from operation of machines at higher speeds, increased range operation, more continuous operation and closer attention to the operation of machinery at its maximum output. The higher speeds will come with better design standards, new handling aids, etc. under the impetus of natural competition.

Range operation is well on its way, with the increased use of continuous processes, and the combination of tandem processes, as was discussed briefly earlier in this paper. Continuous operation also was discussed. I believe that if you were to take almost any machine in your plant, and were to run a machine activity study, you would be amazed at the ratio of total production obtained to the maximum capacity that could be obtained running continuously!

Operation of machines at their maximum output also is receiving closer attention. In the case of drying machines, this means drying to only a nominal amount below normal regain instead of drying to a practically bone dry point. You will all remember the drawn out portion of the drying curve at the dry end. This means that if you are overdrying to say 2%, you may be cutting your capacity by around 20%! Now don't misunderstand me; with the present methods in use this is not simple, and I have every sympathy with the machine operator who is "rated" by the supervisor for allowing wet material to go through. It is only human nature for this same machine operator to over dry the next time. However, we hope that some aids in this respect are on the way.

Higher Quality Requirements

Together with this closer attention to production there will come a more critical attention to quality. We find everywhere more attention being given to the physical treatment of fiber or cloth with view to improving end quality. Starting with the fiber there is a never ending search for methods that give less fiber breakage, better fiber diagram, stronger and more uniform thread, etc. This insistence on improved quality goes all the way through textile processing and ends in the finishing plant, where there is constant development of better and faster dyed fabrics, softer and more luxurious hand, stabilized and crush resistant fabrics, and a host of other specialized finishes that all spell improved quality.

Methods and Tools Available

With this accepted trend to improved quality what are some of the methods used to obtain it? First, in many mills great attention is being given to intermediate quality control tests, and in many companies organized on a vertical basis this program is directly under one of the executive offices. Second, there are new process developments and new machine applications that offer the promise of improvement at various points in the processing. Here again close touch with equipment manufacturers is essential.

Third, automatic instruments are being used on an increasing scale. Temperature and humidity control are being accepted readily. Continuous moisture content readings are an accepted standard on slashers and various continuous moisture content instruments are now available or in the process of development. Various Servo mechanisms operate in conjunction with these automatic instruments to provide automatic control in-

(Continued on Page P347)

Hydrodynamic Test for Water Resistance*

JOHN H. SKINKLE** and MARIO S. LYRA***

Summary

A new test for water resistance of fabrics is described. The test involves the spraying of the fabric with a spray of increasing and measured kinetic energy until an endpoint similar to that of the hydrostatic test (appearance of third drop) indicates failure of the fabric. This endpoint may be correlated with intensity of rainfall. Data given indicates that the hydrodynamic test integrates and combines the results of several other tests into one figure which then rates the fabric for water resistance.

IN presenting another test for water resistance in a field which is already overcrowded with tests, some apology or explanation is necessary. The most convincing excuse for so doing is that the present tests are in general unsatisfactory for one reason or another, the principal reason being that they are based on the fallacy that if we measure the water resistance of a series of fabrics at one set of conditions, the fabrics will be in the same ratio to each other at any other conditions. That this is untrue has been shown many times, most recently and most satisfactorily by Slowinske and Pope *(1)*, who observed this phenomenon in their Rain Room *(2)* results.

A detailed review of present methods of testing is unnecessary in view of the many recent surveys of the field which have been made, most especially that of Rowen and Gagliardi *(3)* and a complete comparison of the various methods now under way by the AATCC research laboratory (unpublished as yet). Briefly, all of the water repellency tests may be grouped under one of four headings:

1. TESTS BASED ON THE CONTACT ANGLE BETWEEN WATER AND FABRIC.—These tests are too complex for routine work and are too insensitive, in that a large number of fabrics show comparatively little difference.

2. TESTS BASED UPON THE ABSORPTION OF WATER BY THE FABRIC.—It is obvious that these tests cannot tell the whole story since the effect of a large mass of water in which the fabric is immersed will not be the same as that of small drops hitting the fabric at high velocity. To cite only one absurdity, it would be possible for a mosquito netting to have zero absorption of water, yet obviously it gives almost no protection from rain. This group of tests does have value in determining the fact that repellant finish has been added and probably its permanency, but that is all.

3. TESTS BASED ON THE RESISTANCE TO PENETRATION OF A BODY OF WATER UNDER A STATIC PRESSURE.—The AATCC hydrostatic pressure test is the commonest example of this. This also has the disadvantage noted above that the effect of a mass of water under a static pressure on the fabric cannot be compared with the effect of small masses of water moving at high velocities and hence with high kinetic energies. In spite of this theoretical objection, however, the hydrostatic test gives surprisingly good correlation with actual service conditions except when multiple layers of fabric are tested. This will be discussed later.

4. TESTS BASED ON THE RESISTANCE TO PENETRATION OF THE FABRIC TO A SPRAY OF WATER.—This test more nearly resembles actual rain in that we have water with a certain velocity (and therefore kinetic energy) striking the fabric. Examples of this test are the AATCC Spray Test, the AATCC Impact Test, Bundesmann test, and the recently adopted AATCC tentative test, the Rain Tester of Slowinske *(1)*. All of these except the last involve the testing of the fabric under one standard set of conditions resulting in a fixed amount of kinetic energy of the water and, as previously stated, fabrics arranged in order of their resistance at one intensity of rain (or kinetic energy) will not be in the same order at another intensity. In addition, the simple spray test is ridiculously easy on the fabric and the other tests all involve measurement of the water transmitted by the fabric. The Rain Tester, it is true, allows one to vary the kinetic energy of the water striking the fabric, but if this is done, a whole series of weighings must be made at the different heads of water pressure and at different periods of time. For classification purposes, the drop tester may be considered as a single-holed spray and put in this group, also.

In view of the above, then, the authors believe that there is a need for a water resistance test with certain desirable features:

1. The test should correlate well with actual rain of any intensity.

2. The test should be carried out under such conditions that the fabric is backed up with a solid, non-absorbent material. Slowinske *(4)* in his rain room results has shown that the first penetration of rain in actual use occurs at the shoulders and that if an absorbent fabric is behind the test fabric, leakage occurs under conditions which would normally allow the fabric to resist the rain. In spite of this fact, several of the spray tests back up the fabric with blotting paper.

3. The test should be sensitive to small differences in the fabric, even at high degrees of resistance. The impact test, for example, rates too many fabrics as zero (the highest rating) without distinguishing between their degrees of goodness. The test therefore must continue until the fabric does fail, and therefore the test must be one which can be continued with increased severity until failure occurs.

4. The test should be capable of being carried out under an increasing kinetic energy or rainfall intensity until failure results, since one fabric may be very good at low intensities but poor under higher, while another fabric might be good under both low and high intensities. If a single intensity were used, both fabrics would be rated equal.

5. The effect of double layers of fabric should be shown by the test. Slowinske again *(1)* has shown that in actual use, two layers of rather poor fabric may be much superior to a single layer of a very good fabric. The Rain Tester and the Impact Test show this but the Hydrostatic Test does not;

*Presented at joint meeting, Lowell Textile Institute Student Chapter and Northern New England Section, April 16, 1948.

**Assistant Professor, Lowell Textile Institute.
***Graduate Student, Lowell Textile Institute, now of Rio de Janeiro.

doubling the number of layers of fabric in the Hydrostatic Test simply increases the results by two or three centimeters.

6. The end point of the test which shows when failure has occurred should be simple, and in the interests of commercial testing, should be quick and not require weighings. The hydrostatic test end point is desirable—the appearance of the third drop on the opposite side of the fabric from which the water is applied.

7. The result of the test should be capable of expression as a single figure rather than as a table of figures at different intensities. This figure should preferably be the greatest intensity of rain or greatest kinetic energy which the fabric will withstand.

The authors believe they have arrived at such a test and have named it the "Hydrodynamic Test" because of its similarity in certain respects to the hydrostatic test, coupled with the fact that the water is not inert but is in the form of a spray of variable but measurable kinetic energy.

Hydrodynamic Test

The apparatus for the hydrodynamic test is shown in principle in Figure 1 and photographs of the details are given in Figures 2 and 3.

Referring to Figure 1, running water at tap pressure, and a temperature of 80 ± 2°F, enters through a rubber tubing and arrives at the first tee; at this point the flow divides with the greater part flowing through a by-pass line to the sink, and this flow is controlled by a screw clamp or a needle valve. The remainder of the water flows on to a second tee where the flow divides, part going to a spray which throws its shower upward against the fabric; the other arm of the tee is connected with a manometer made from a filter flask and vertical tube with a centimeter scale to register the pressure of the water at the spray. The spray head is the same one used in the present AATCC Spray Test and consists of a rounded face with 19 holes made with a #65 drill. The rounded face is essential since water falling back from the fabric would clog a flat surfaced spray. Trials with the spray used in the Impact Test were unsuccessful for this reason.

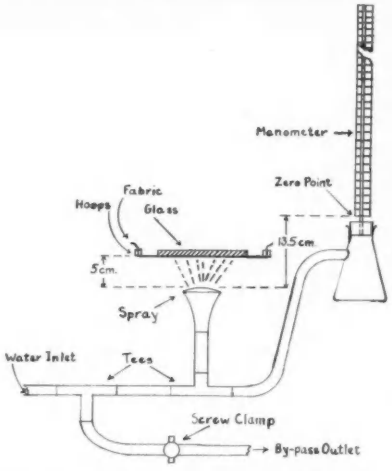

Fig. 1—Diagram of Hydrodynamic Tester

Exactly 5 centimeters above the top of the spray is placed the fabric to be tested, face downward to the spray and stretched between the hoops of an embroidery frame (same as is used in the Spray Test). This stretched sample is held in position by a tripod (see Figures 2 and 3) and above it is placed a piece of quarter-inch thick plate glass cut in the form of a circle of 4.5 inches diameter weighing 150 grams. This glass serves a three-fold purpose:

1. It holds the fabric under a constant tension.

2. It acts as a hard non-absorbent backing for the fabric.

3. It makes the appearance of drops of water on the back of the fabric very sharp and clear. As soon as a drop comes through the fabric, it immediately spreads out to a dark circle about half an inch in diameter by filling the capillary space between the glass and the fabric.

The position of the manometer is so adjusted that when the spray just barely reaches the sample (kinetic energy zero), the manometer is at zero on the scale.

To obtain water at tap pressure and the required temperature, an electric heater was used, but if running hot and cold water are available the standard temperature may be obtained by mixing the two and regulating the flow of each; a thermostatic mixing valve, such as is used for shower baths, would be an obvious aid here.

The procedure for carrying out the test was as follows:

1. Samples seven inches square were cut out and conditioned at 70°F and 65% relative humidity. These conditions were found to be not too critical.

2. A sample was placed in the hoops and placed face downward on the tripod; the glass plate was set on top.

3. By closing the screw clamp on the by-pass, water was diverted into the spray and the pressure on the spray was increased at the rate of one centimeter every 5 seconds. The upper surface of the fabric was watched.

4. As soon as three drops appeared on the upper surface (a very sharp end-point) the manometer was read to the nearest centimeter.

5. Further tests were made in sufficient number to give a good average. A discussion of the proper number is given later.

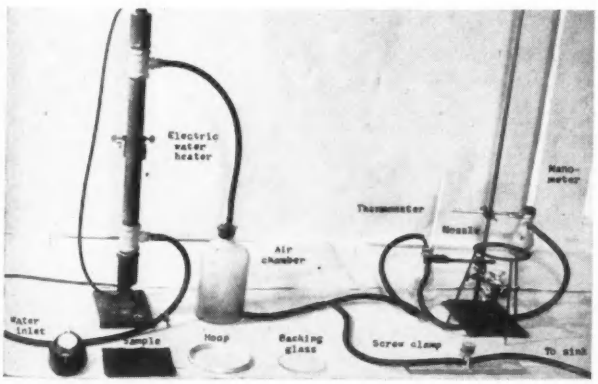

Fig. 2—Photograph of Hydrodynamic Tester (Source of Constant Temperature Water Included)

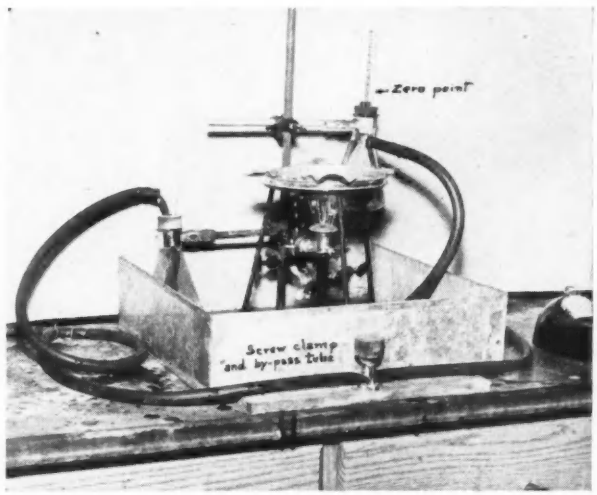

Fig. 3—(RIGHT)—Close-up of Spray and Fabric

Theory

If we let

V = velocity of the water as it strikes the fabric in centimeters per second

V_0 = velocity of the water as it leaves the spray in centimeters per second

V_5 = velocity lost in travelling 5 centimeters to reach the fabric (this is numerically equal to the velocity attained in falling 5 centimeters) in centimeters per second

h = pressure of water at the spray in centimeters of water

H = manometer reading in centimeters of water

c = orifice coefficient of the holes in the spray. This should theoretically be 0.61 and was found by experiment to be 0.609

10—9261 IRV 8 gara bld on 10 10

Then

$$V = V_0 - V_5$$

and by the orifice formula

$$V_0 = c\sqrt{2gh} = 0.609\sqrt{2x980h} = 27.0\sqrt{h}$$

by the formula for falling bodies

$$V_5 = \sqrt{2gs} \text{ where } s = 5 \text{ centimeters}$$

$$V_5 = \sqrt{2x980x5} = 99.0$$

Then

$$V = 27.0\sqrt{h} - 99.0$$

and it may be seen that the pressure h may be used as a measure of the velocity of the water striking the fabric.

However, we are measuring only H which is the pressure above that necessary to reach the fabric. Experiment showed that the zero point on the manometer was 13.5 centimeters above the spray when the water just reached the fabric, so

$$h = H + 13.5$$

and

$$V = 27.0\sqrt{H + 13.5} - 99.0$$

The holes in the spray were carefully measured under a microscope and their average diameters were found to be 0.0763 centimeters. The total area of the 19 holes would then be

$19x0.7854(0.0763)^2 = 0.087$ square centimeters

The flow of water from the spray would then be

$$F = .087V_0$$

$$= .087x27.0\sqrt{H + 13.5}$$

$$= 2.35\sqrt{H + 13.5} \text{ cubic centimeters per second}$$

If we assume that the density of water is 1.00 gram per cubic centimeter, then the kinetic energy of the water striking the fabric per second is

$$KE = \frac{FV^2}{2g}$$

$$= \frac{2.35\sqrt{H + 13.5}\,(27.0\sqrt{H + 13.5} - 99.0)^2}{2x980}$$

$$= \frac{\sqrt{H + 13.5}\,(27.0\sqrt{H + 13.5} - 99.0)^2}{800}$$

TABLE I

Properties of the Fabrics Tested

Number	Name	Weave	Count warpxfill	Weight oz/sq yd	Air Permeability cu ft/min/sq ft
6	Byrd cloth	Twill	114x98	5.1	12.1
8	Poplin	Plain	116x72	4.6	33.5
9	Twill	Twill	104x52	7.2	21.5
10	Boat cloth	Sateen	80x88	7.4	9.0
11	Oxford	Plain	136x56	7.2	5.5
12	Untreated duck	Plain	54x64	8.1	10.0
13	Jungle cloth		48x230	13.8	9.0
14	Poplin	Plain	108x54	5.8	12.0
16	Duck	Plain	48x36	13.1	6.5
17	Poplin	Plain	126x50	4.8	36.5
18	Poplin	Twill	106x46	6.8	17.5
19	Shirting	Plain	106x106	3.3	37.0
21	Poplin	Plain	114x52	6.2	39.0
21A	Poplin	Plain	114x52	6.2	39.5
23	Poplin	Plain	104x52	6.4	10.0

Samples 21 and 21A are the same fabric made at different times, dyed differently, but finished the same.

TABLE II

Results of Water Resistance Tests
(Arranged in Descending Order of Results on Hydrodynamic Test)

Sample Number	Hydrodynamic Test cm of water pressure	Hydrostatic Test cm of water pressure	Impact Penetration grams of water penetrated	Lowell Test minutes to penetrate
11	114.+	61.4	0	60+
10	89.8	46.5	0	60+
21A	79.6	42.3	0	9
13	75.7	39.1	0	60+
21	72.7	42.0	0.1	12
16	66.1	41.7	0.1	60+
12	45.3	33.1	0.1	7
6	45.2	46.8	0.1	8
23	45.2	32.5	0	
18	37.5	28.6	0.2	
14	35.7	32.0	0.1	
9	35.6	26.3	0.3	
17	30.4	24.8	8	
19	21.0	22.3	10	
8	17.4	23.0	7	

TABLE III

Hydrodynamic Test—Effect of Number of Tests Per Sample

Sample Number	Ten Tests		Five Tests		Three Tests	
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
11	114.+	—	114.+	—	114.+	—
10	89.8	0.44	90.0	0.45	90.0	0.57
21A	79.6	1.40	81.6	1.75	80.3	2.59
13	75.7	2.04	75.7	2.04	75.0	2.41
21	72.7	1.79	71.5	2.11	69.6	2.81
16	66.1	0.81	65.8	1.56	64.3	1.50
12	45.3	0.70	44.0	1.05	45.0	1.51
6	45.2	0.45	44.6	0.81	44.3	1.55
23	45.2	0.96	46.0	1.73	46.3	1.52
18	37.5	0.56	37.2	0.86	36.6	1.79
14	35.7	0.84	34.6	1.11	33.6	2.30
9	35.6	0.31	35.6	0.38	35.3	1.12
17	30.4	0.87	30.4	1.56	29.7	2.39
19	21.0	0.45	20.8	0.85	20.0	1.15
8	17.4	0.44	17.2	0.92	16.0	1.00
Average Standard Errors		0.80		1.16		1.61

TABLE IV

Hydrodynamic Test—Effect of Rate of Pressure Change
Pressure on Nozzle Changed at Rate of One Centimeter of Water in

Sample Number	2.5 Seconds		5.0 Seconds		10.0 Seconds	
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
6	51.2	1.38	45.2	0.45	50.1	1.56
14	40.3	0.94	35.7	0.84	35.5	1.03
17	28.2	1.57	30.4	0.87	29.4	0.65
19	20.6	0.49	20.7	0.45	21.7	0.54
21	71.6	2.08	72.7	1.79	69.9	1.54
Average Standard Errors		1.29		0.88		1.06

TABLE V

Hydrodynamic Test—Effect of Water Temperature

Sample Number	Temperature of Water at Spray 70°F.	75°F.	80°F.
8	18.3	18.3	17.4
14	40.8	37.8	35.7
23	44.8	45.2	45.2
21	70.0	72.5	72.7

TABLE VI

Effect of Single and Double Layers of Fabric

Sample Number	Hydrodynamic Test Single Layer	Hydrodynamic Test Double Layer	Hydrostatic Test Single Layer	Hydrostatic Test Double Layer	Impact Test Single Layer	Impact Test Double Layer
8	17.4	114+	23.0	25.6	7	0
19	21.0	114+	22.3	28.6	10	0
17	30.4	114+	24.8	26.3	8	0

TABLE VII

Hydrodynamic Test—Kendall Coefficients of Correlation

Correlation With:	Degree of Correlation
Weight of fabric	47%
Air permeability	45%
Hydrostatic test	83%
Impact penetration test	83%
Lowell test	87%
Composite of hydrostatic, impact, and Lowell tests	87%

TABLE VIII

Comparison of Fabrics with Same or Similar Values in Two Tests

Values the same:	Hydrodynamic Test	Hydrostatic Test	Impact Test	Lowell Test
A. LOWELL	114+	61.4	0	60+
AND	89.8	46.5	0	60+
IMPACT	75.7	39.1	0	60+
B. HYDROSTATIC	89.8	46.5	0	60+
AND	45.2	46.8	0	8
IMPACT				
C. SAME	45.3	33.1	0.1	7
HYDRODYNAMIC	45.2	32.5	0	5
D. SAME	35.7	26.3	0.1	1.0
HYDRODYNAMIC	35.6	32.0	0.3	1.3

It is obvious then that the kinetic energy exerted on the sample is measured by the value of H.

Data

Table I is a list of the fabrics tested with their relevant properties. All of these fabrics except one (#12) had been treated with a water repellent finish of some kind. It will be noted that there is a wide range of weaves, yarn counts, weights, and air permeabilities; and it may be stated now that no appreciable correlation of these properties with water resistance was found.

Table II gives the results obtained on the above fabrics arranged in order of the results of the hydrodynamic test. There are also given the results of three other tests—hydrostatic, impact, and the so-called Lowell test. The Lowell test was devised, as a research tool only, at the AATCC research laboratory in Lowell; it will be explained in more detail in a forth-coming publication, but briefly it is a more intense impact test, the water falling from a height of 6 feet onto the fabric and continuing until failure of the fabric, which in a good material may be more than an hour. On account of this time factor, the test is wholly unsuitable as a routine test although excellent as a research procedure where high kinetic energies are required. The hydrostatic and impact tests are standard tests of the AATCC and require no description. It will be noted that these three tests form a logical series; the hydrostatic test subjects the fabric to a static pressure with zero kinetic energy, the impact test subjects the fabric to a spray of low kinetic energy, and the Lowell test subjects the fabric to a spray of high kinetic energy. Examination of Table II shows a general correspondence of the three tests with the hydrodynamic test; deviations from exact correspondence will be discussed later.

Table III gives the effect of the number of tests made on each fabric on the results obtained by the hydrodynamic test. As might be expected, ten tests give a smaller standard error than five, and five tests are better than three. It will be noted, however, that only small differences exist between the results of ten tests and five, less than the standard error. It would be unneccessary therefore to make more than five determinations for any one fabric. A slightly larger difference exists between five and three tests in some cases, but if go and no-go standards were to be set up three tests would in general be enough, unless the fabric turned out to be a border line case. In general, we may say that five tests would be the standard method.

Table IV gives the effect of varying the rate of pressure change on several different fabrics. It will be noted that while the effect is small it is contradictory—in some cases a faster rate means a higher value and in other cases a faster rate results in a lower value. One centimeter in 5 seconds was adopted as standard because of the lower standard error obtained at this rate and because it is a convenient time to read the watch, adjust the pressure, and observe the fabric during operation of the apparatus. Incidently, to save time after the first sample is run at the standard rate, succeeding samples may be brought up to a reading of about 10 centimeters below the expected final result almost instantly and then revert to the standard rate for the last 10 centimeters.

Table V on the effect of water temperature on the results shows again the same alternation of low and high results on decreasing the temperature. Again the effect is small, but 80 ± 2°F was adopted as standard since it is more convenient to heat water up to a standard temperature than to cool it down. It is also the standard temperature for other water resistance tests.

It was stated in the introduction that a suitable water resistance test should show the same effect on multiple layers of fabrics that are shown in actual use. Table VI shows that if we take the three poorest fabrics (based on the hydrodynamic test) and test double layers, the results are better than a single layer of the best fabric. This is also true of the impact test, but it may be seen that the hydrostatic pressure results are raised only a few centimeters by using double layers. This phenomenon is further verification of the kinetic energy concept of testing water resistance; one layer no matter how poor, would reduce the kinetic energy of the drops to the point where they could no longer penetrate another layer of poor material.

Table VII gives the calculated rank correlations, using the Kendall method, of the hydrodynamic results with other measured properties of the fabrics. It will be seen that the correlation with fabric weight and air permeability is very low, but that the correlation with all three of the older water resistance tests is very high. The correlation with the composite of the three tests is highest of all. This leads the authors to think that the hydrodynamic test gives us an integration of the results of all possible kinetic energies on the fabric; if

(Concluded on Page P348)

The Finishing of Cottons and Rayons*

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IT is my plan in a talk of this nature to cover very briefly the entire processing route for both cotton and rayon from the point where it is received as grey goods in the plant to where it is in final shape for delivery to the converter or directly to his customers—the cutter, or the fabric store. However, the accent will lie on what is done to these materials in the final stages of the finishing operation, particularly what is accomplished by specialized chemical and mechanical treatments. That is to say, after the goods have been scoured and dyed or printed it is necessary to give them, in many cases, a particular finish such as glazing, schreinering, shrinkproofing, creaseproofing, plissé, etc. It is the manner in which these results are accomplished, and to some extent the interpretation of why they do result, that I think will be of the greatest interest.

I. Preparation

A. Starting with cotton grey goods the following steps occur. Cloth may be received by the mill in a variety of forms, therefore it is necessary that it be laid out and the ends sewn so that the initial treatment can be carried out continuously. Laid out cloth first goes through the singer at a high speed, where the fuzz is burned by means of a gas flame or red-hot bar which may operate on either one or on both sides of the fabric, depending on the necessity. From here the fabric is led directly into a quenching bath which serves a double function. It puts out any still-glowing threads and also impregnates the cloth with an enzyme, or sometimes a mild acid sour. The purpose of the latter treatment is to solubilize starch sizing which had been added to the threads to facilitate weaving. After standing a length of time suitable to accomplish this purpose the material is washed, usually in a tight strand washer, and piled in kiers.

A 5-ton kier will hold 7,000 or 8,000 pounds of cloth, or 10,000 to 60,000 yards, depending on the weight per yard. The prime ingredient in the kier boil is caustic soda of approximately 2% strength. In most bleach houses a variety of assistants are used, including pine oil and/or specialty soaps and various phosphate compositions, which have the property of sequestering heavy metal cations. Generally a kier is operated at 10 to 15 pounds pressure for from 4 to 15 hours' time.

The caustic solubilizes wax-like components and pectins, in other words, the non-cellulosic constituents of the raw cotton. The additives to the kier hold heavy metal salts in solution, thus inhibiting the formation of what would otherwise result either in discolorations or resist spots interfering with later dyeing.

After kiering, the fabric is again washed and led through a bleach solution, generally calcium or sodium hypochlorite of about one-half gram per liter available chlorine. It is piled in pits until bleaching is completed, for one-half to several hours, is washed again and led through an anti-chlor treatment, for instance a sulfur dioxide solution. The cotton has now been successfully relieved of the starch sizing, waxes and pectins, motes, and other foreign matter and given a whiteness which we all associate with high quality bleached cotton fabric.

The bleached material is then dried either on cans or on a tenter frame, and is wound on a shell for subsequent processing. Cloth for printing is generally frame dried, though heavy cloths may be dried on the cans. Material to be plain dyed is frequently mercerized and is so handled as to prevent chafe marks which would show up in dyeing.

B. For rayon a somewhat different treatment is required. If necessary the rayon material is singed after laying out, which is of course the first step in the process. Then the fabric is, if required, desized. In many cases the sizing compound is not a starch but a readily water-soluble material which can be removed without the necessity of enzyme treatment. The bleach house foreman or chemist determines what is required in each case. The cloth is then scoured on the jig, kettle, or in a continuous boil-off machine. Usually cloth to be dyed in light shades, or intended for printing, is bleached. In the treatment of rayons a hypochlorite is not used as the bleaching agent, but rather a hydrogen peroxide or sodium chlorite. In general a silicate compound is added with the peroxide to act as a buffering agent.

With rayons it is obvious that the primary treatments are considerably less strenuous than with cotton, and for obvious reasons. The rayons are a man-made fabric and consists already of quite pure cellulose. However, in the preparation of these materials the cellulose has been degraded, so when it is made into a fiber the fine structure is considerably different from that of the natural cotton fiber, in that it is less closely packed and more readily swollen and dissolved. A major difference in most rayon is its lack of strength in the wet condition. Handling of this fabric must therefore be with a minimum of tension.

II. Printing and Dyeing

We have now come to the point where both our cotton and rayon materials have been made suitably clean, white and absorbent, so that they may be either printed or dyed. Dyeing in either case may be with directs, diazotized and developed, sulfurs, dispersed colors, vats, or naphthols. The choice, is determined by the customer's requirements for fastness, and also, in some cases, by whether the material is going to be subsequently printed with a paste capable of discharging the ground color. In any case there are no residual materials other than the dyestuff which remain after dyeing.

On drying, however, the cloth, whether cotton or rayon, is not in a suitable finished condition. In general the fibers are stiffened and unlubricated. They are also too greatly dehydrated, and must therefore be suitably softened, lubricated, and moistened by subsequent treatment. Printing may be done with all the various types of dyestuffs suitable for cellulosic fabrics such as azo types, soluble leuco esters of vat dyestuffs, vats themselves, or pigments. In each of these cases the paste usually has a thickening agent containing starch, and is deposited with the color on the cloth.

The thickening agent serves to put the

* Presented at meeting, Northern New England Section, March 19, 1948.

dyestuff in a suitable shape for yielding a sharp imprint, and the final result is that the dye principally colors the fabric. After printing the cloth is can dried, aged, and finally soaped to remove extraneous materials. Nevertheless there is always some excess of dyestuff present in loose form, and the starch itself is not too easily removed after the drying operation. Thus the printed material differs from dyed material in that it usually contains excessive amounts of difficult to remove, starch-like deposits in those parts of the fabric which were printed.

III. Finishing

INTRODUCTORY.—We have now brought our fabrics to the point where they have been suitably cleaned and embellished but still require a final treatment to make them suitable for merchandising. The finisher is a specialist in "hand." Hand is a kind of non-substantive entity. Primarily it is a subjective response to tactual sensation. In other words, to be well qualified as a finisher, you should have the early training of an artist with subsequent courses in safe-breaking.

There have been a few devices created for evaluating hand, for instance the Planoflex, Frictionometer and Drapemeter; but practically the tactual method reigns supreme in use.

There is a vocabulary for hand from which I have collected just a few of the many terms used for describing the sensation of cloth. For instance, a fabric may be called round, stringy, silky, smooth, raggy, soft, boardy, papery, full, firm, heavy, light or thin. Many of these terms are self-explanatory, but with others you can only relate what *you* feel with the word. Among finishers there is usually a fair agreement as to the sensation. Between finishers and the customer there is an occasional conflict.

A. MACHINES FOR MECHANICAL EFFECTS.—Before going on to the finishes themselves, let me describe the machines which are used to yield mechanical effects.

1. Calender. Calenders generally break up and soften the hand. The calender rolls may be made of the following materials: steel the hardest; cotton next; then paper; and husk, the softest. It is an invariable rule that hard and soft rolls are used together to avoid tearing the cloth. When hot rolls are used more luster results. With a plain calender the choice of 2- or 5-roll machine depends on the amount of effect needed. Almost all percale is calendered. Very little drapery material is thus treated. A friction calender is used for a glazed finish. A schreiner calender is used on sateens. The schreiner calender possesses one roll which has a multitude of very fine lines engraved in it. When these are impressed on the satin-faced cloth a very high luster is imparted. The chasing calender is used to give a linen-type finish. It is so set up that a number of strands of cloth are continuously passed between the calender bowls. As a result each strand passes from top to bottom through the layer and is therefore pressed a number of times between layers of cloth before it is finished. This process gives a deep luster and a round thread to the fabric.

2. Tenter Frame. Tenter frames may be either long or short, 20 to 90 ft. in length, open or enclosed, depending on the purposes for which they are intended. Their primary purpose is to finish cloth to a given width. A special type of frame known as a swing frame yields a longitudinal reciprocating motion as the cloth travels through the frame, and thus loosens and straightens the filling threads of the fabric which is being dried. By this method it can straighten frays on loosely woven materials such as voiles, etc.

3. Driers. In addition to tenter frames and cans which may be used for drying, there are various types of slack driers such as loop driers, Air-lay, and net driers, all of which have as their primary purpose drying in the absence of any tension either warpwise or in the filling. For practically all treatments on rayon cloths it is necessary that such a slack drier be used, as both frames and cans tend to give a harsh, stiff effect.

4. Decaters. A decater is a single, perforated bowl onto which cloth is wound continuously backed with a layer of canvas, perhaps 700 yards being applied at one time, depending on the weight. When the entire piece has been wound, dry steam is admitted through the perforations in the bowl until the vapors appear at the external surface of the final layer of canvas. After standing thus for a few moments, moisture is removed by a vacuum pump and the cloth is wound off. This treatment swells the fibers, making them round and mellow. At the same time the treatment has the effect of removing any wrinkles. Some slight warpwise stretching may be expected in this treatment.

5. Button Breaker. A button breaker is generally used for correcting an overstiff hand. This machine consists of a number of bumpy rolls through which the cloth is threaded. The manipulation of the fibers tends to break any harshness which is present.

6. Mangle. The mangle is a machine absolutely necessary for the application of the various finishes themselves. It does not, therefore, produce mechanical effects itself, but is auxiliary to them.

B. TYPES OF CHEMICALS USED.—1. *Starches and gums.* For weighting, filling, and firming.

2. *Sulfonated esters such as sulfonated castor oil, sulfonated olive oil, teaseed oil, rapeseed oil, etc.* These are for non-permanent softening action.

3. *Tallow emulsions.* Principally used for cotton softening.

4. *Wax emulsions.* Also for softening cottons, and non-durable water repellency.

5. *Cationic agents.* For durable softening.

6. *Resins.* Urea-formaldehyde and melamine-formaldehyde, styrene and methacrylate dispersions.

7. *Clays and pigments.* As fillers when required on loosely woven fabrics.

8. *Durable water repellent compounds.* Such as Zelan, Norane, Permel, Dolanize, Cravenette, etc.

9. *Glyoxal-formaldehyde.* For rayon shrinkproofing.

10. *Caustic soda.* For the rayon shrinkproofing method.

11. *Cellulose derivatives.* Ethers, degraded cellulose, etc.

C. FINISHES.—1. *Non-specialty Finishes on Printed Cottons.* As was mentioned earlier, most printed materials carry a certain proportion of starch which remains from the thickening in the printing paste. Consequently the final treatment depends to some extent on whether or not there was a printed ground containing starch, or a ground which has not changed since the original bleaching. If the entire cloth is stiffened, it is generally necessary only to add a softening agent such as a sulfonated oil or a wax emulsion, and give a final calendered finish. If on the other hand there are only small interrupted printed areas, a certain amount of starch or other stiffening agent is added in conjunction with the softening agent in order to equalize the entire area of the fabric. Heavy drapery materials are treated not too differently from the lighter cloths, again dependent upon the extent of the printing. For sheer fabrics such as Lawn, a light, transparent gum is used along with a sulfonated oil.

2. *Plissé.* This is a rippled material which is produced by the action of caustic soda on cotton. The caustic, from 31 to 43% concentration, is suitably thickened for printing and is applied usually in stripes from a copper roller. The effect is to cause a shrinkage on those fibers with which it comes in contact. The cloth is then neutralized and washed to remove the alkali. The shrinkage, which is from 15 to 20% warpwise, results in a puckering in those portions which were not treated with the agent. In addition there is a takeup of up to 25% in the filling.

The types of cloths which most successfully react to this process have a lower filling count than warp, for instance a 60 x 48, or 64 x 56 cloth is very well suited to the treatments. The higher constructions are of somewhat greater durability. It is possible to accomplish a very interesting plissé effect through a resist printing process. By this method a caustic-resisting area can be printed on the cloth, along with a variety of colors, and then the entire fabric is passed through caustic or mercerizing strength, which shrinks all portions except the resisted area. Novel interrupted effects are produced by this method, which may also be colored.

3. *Durable Glazed Chintz.* In recent years a very large volume of durable glazed chintz has been processed. The essential ingredient for durability is an alhehyde amine resin such as urea-formaldehyde or melamine-formaldehyde. About 5% of resin along with a catalyst for its cure, and a softening agent such as sulfonated castor oil, or some synthetic type, are used for an impregnating bath applied on a pad mangle. The cloth is then partially dried on an enclosed tenter frame, which is an essential part of the procedure. Slightly damp, the cloth is then friction calendered. This imparts a highly glazed surface to the printed side. By curing at an elevated temperature the resin is set and the glaze made durable. It has been considered by many observers that the durability of the glaze is due simply to the presence of hardened resin particles on the surface of the cloth. In our opinion, however, it is much more likely due almost solely to the diminished ability to swell which the resin treated fabric possesses. It is possible, for instance, to produce a durable glazed surface using an aldehyde alone as the agent; though the embrittlement produced on cotton fabric by this treatment so diminishes the tensile strength that it is not practical.

4. *Shrinkproofing.* This applies primarily to rayons when accomplished by chemical means. There are several methods currently used to accomplish this result. The glyoxal treatment is carried out by reacting a rayon fabric with the aldehyde in the presence of a catalyst. The aldehyde groups apparently react with free hydroxyl groups present in the cellulose, linking molecules together in such manner that a higher molecular weight results. This is no longer capable of swelling to the same extent as the original untreated rayon. Higher wet strength results by this treatment, and also a considerably diminished tendency to shrink or extend. Treatment with either urea-formaldehyde or melamine-formaldehyde resins apparently performs a function similar to that of the aldehyde; that is, a cross-linking of molecules again occurs, only this time in place of a simple methylene or ethylene connection, an entirely complex resin molecule is insolubilized within the body of the fiber. Again a diminished tendency towards swelling, shrinking or extending results. With resins it is necessary to make a choice, when treating white materials which may subsequently be laundered with chlorine, so that the resin will not retain chlorine, probably as a chloramide, which would later tender the fabric when ironed. Such resins are currently available. In any case, when treating rayons it is essential that the chemical be applied in such a way that it is permitted to enter into the fiber. They should, therefore, be preferably in a moist and slightly swollen state, and should be handled slack in all processing. Care should be taken that in final finishing they be set without extension such as would give initial shrinkage on the first laundering.

These same remarks apply to a crush- or wrinkle-resistant finish, with the exception that an increased amount of resin is usually applied. Modifying agents may be added to lubricate the fibers. Generally shrinkage may be accomplished with about 5% of resin, whereas 10 to 15%, or even more in some instances, may be required for crush resistance. The results do not reach a maximum for at least several days after conditioning at 70 degrees F. and 65% relative humidity.

5. *Sanforizing.* At the present time Sanforizing is probably the favorite method of getting shrink resistance on cottons. The cotton material, which may have been prepared with a wetting agent and other finishing materials, is first sprayed lightly with water, then carried through the Sanforizing machine. This mechanically compresses the fabric warpwise by bending it over a small diameter roll, along with a heavy woolen blanket, to a predetermined takeup, which was found by washing a sample piece. Thus the shrinkage which would normally result in washing is mechanically forced into the fabric. At the same time a desirable hand is given, probably due partly to the elasticity resulting in the fabric, as well as to the effect of moisture and the blanket.

6. *Water Repellent.* Permanent water repellent effects are achieved by padding material through a bath containing a suitable durable water repellent suspension. This is generally dried into the cloth, then cured in manner similar to that for the urea- and melamine-type finishes. It is finally washed and finished on a frame as required.

7. *Permanently Stiffened Finishes.* The original finish is the Heberlein, which results from a sulfuric acid treatment of a cotton fabric. It is related to the various parchmentizing methods for cellulosic materials, and is permanent because it consists entirely of cellulose.

The sulfuric acid partially dissolves the fabric. It particularly removes the fine threads and fuzz which normally project into the interstices of, and above the surface of, the fabric. The partially dissolved cellulose on the surface does not have time actually to go into solution, and is gelled by subsequent passage of the cloth into cold water.

The separate fibers are bound into a single bundle which transmits more light than the original strand, and with the diminished amount of interstitial fuzz yields a clean transparent fabric.

Another method of accomplishing the same results is by means of another cellulose solvent, copper ammonium hydroxide. The result is similar to that obtained with sulfuric acid.

In each of these cases a great deal of care and control must be exercised to avoid damaging the cloth.

Other methods for permanently stiffening fabric generally embrace the *addition* of cellulose, cellulose derivatives, or resins and plastics to the material.

Cellulose which is sufficiently degraded to be soluble in sodium zincate solution is available, as well as cellulose ethers soluble in dilute caustic soda alone. When the cloth is passed through such solutions, squeezed, and coagulated in another bath, a deposit of cellulosic substance is made. This is durable to most treatments to which the cloth will be subjected.

Polyvinyl alcohol solutions which can be insolubilized by means of aldehyde-amine resins, such resins themselves which are by nature crisp rather than soft, suspensions of acrylic type resins or alkyds, are all used additionally for permanently stiffened finishes.

The results differ in hand and appearance, as well as durability from the Heberlein or cuprammonium-treated fabrics. They have the great advantage of being possible to apply on usual equipment without especial precautions or control.

8. *Flameproofing.* Within the last few years the demand for a durable flameproof finish has been increasing. The non-durable type of flameproofing consists in the impregnation of fabric with suitable water-soluble salts which have the property of making the ignition of cellulose extremely difficult, and of inhibiting any tendency toward afterglow.

Boron salts, ammonia phosphates, sulfates and sulfamates are characteristic compositions. One's first thought in flameproofing is to provide a sufficient amount of a non-combustible material to deter

the combustible portion from burning. Actually the problem is considerably more complex. But at least one phase of it is that the chemical additive should so influence the action of heat on cellulose that difficultly combustible products are formed; i.e., carbon and water rather than carbon monoxide, methanol, hydrocarbons, etc.

For a durable flameproof finish two possibilities are open; one, the addition of a flameproofing agent held by means of a binder; and two, the modification of the cellulose by chemical reaction with the flameproofing material.

In the first case a suitable treatment consists of an antimony oxide—polyvinyl chloride compound. For the second, the reaction of urea-phosphoric acid with cellulose can be used. The considerations which govern the choice of method are effectiveness, required add-on, hand, cost, and loss in tensile strength.

Without doubt improved methods will be found in the future.

9. Crepe. The warp may be either acetate or viscose. The filling is uniformly viscose. There may be 3,000 to 5,000 warp ends for a 40" fabric. These must be sized in order to retain their shape with the high twist which is given to them. Acetate threads usually have a sizing stretch of 3 to 6%, viscose 5 to 10 %. They are given a twist of 55 to 65 turns per inch. The types of constructions most generally used are as follows:

(a) Voiles and georgettes which contain highly twisted threads both warp- and fillingwise.

(b) Crepe de chine, marocain, satin-back crepes which contain a highly twisted filling.

(c) Moss crepe which contains twisted and untwisted yarn doubled together, either warp- or fillingwise, or both.

To produce the creped effect the sizing must be removed from the threads, which are then in condition to double up in the cases where they are highly twisted, and to swell. The pebbly appearance of the crepe is then accomplished by the compacting of the swollen yarns, coupled with the random pulling exerted by the twisted yarns. After the boiling-off operation which produces the crepe effect, the cloth is dyed and finished. There is a strong tendency for crepe fabrics to shrink when laundered. They may therefore be given the usual shrinkproof treatment with alhehyde-amine resins, or straight aldehyde treatments such as glyoxal, to stabilize the fabric.

10. Miscellaneous. A variety of other finishing treatments may be given cotton and rayon fabrics. For lining materials and night clothing napping is frequently resorted to. The card cloth of the napping machine pulls the fibers from the surface of the fabric, yielding after a passage of from 5 to 15 times through the machine, something which we all recognize as cotton flannel. In general the effect is primarily on the filling threads, and as a result the filling strength may be considerably diminished. Napping is sometimes used as a method of softening a stiff fabric. In a recent patent the use of amine-formaldehyde resins is claimed for the production of a durably napped finish.

Often in processing it is necessary to produce a non-slip finish. This is particularly true in working with lace materials. There are a number of products marketed which have the ability to reduce slippage by increasing the frictional resistance of the crossed threads. Resins as well as colloidal silica have been used for this purpose.

The gas-fume fastness of dyed acetate goods, particularly those dyed in shades of blue to green, is poor. The fumes arising from the combustion of coal contain nitrous oxide which reacts with the amino groups of the dyestuffs. Since these groups are the auxochromes which yield the desired blue shade, their conversion to a diazonium compound, for instance, results in a shade lightening in general to a pink. This may be avoided by treating the cloth with a compound which reacts preferentially with the nitrous acid. Compounds of this nature usually contain free amino groups of their own which are more active than the amino groups in the dyestuff. They are applied from a suspension, dispersion, or solution, and for the most part are not durable.

Delustering is another frequent requirement for finished rayon goods. It may be accomplished by the addition of delustering pigments such as titanium dioxide, or by producing a superficial deposit of finely divided resin such as styrene on the surface of the material.

Another method is by the addition of compounds such as phenol which, when dissolved in the material being treated, produces a change in the refractive index to change the light reflection.

A requirement which was of particular necessity during the war was of mildew repellency, especially for cotton goods. Here the finishing treatment embraces the addition of a chemical agent to the cellulose so that it is no longer a food for microorganisms. Compounds which are useful for this purpose are the heavy metal naphthenates such as copper naphthenate, mercury compounds, chlorinated phenolic materials and the like.

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Textile Drying—

(Continued from Page P339)

dependent of the action of any operator. Many of these were developed during the war and will see increasing application by industry during the next decade. Let me digress a moment and give you some idea of what is possible in these mechanisms. You have all heard of the wonders of radar, but let me tell you what was the normal action of an American anti-aircraft battery of 90 mm. guns. During the middle of the night the search radar operation would pick up a target and switch to automatic operation. From that point the radar automatically tracked the target giving direction, angle of elevation and range. These elements were transmitted automatically to the computing mechanism, where the future position of the target and firing data were computed and automatically transmitted to the individual guns. The guns accepted and moved automatically in accordance with this data. The only manual operation required in the entire process was the actual loading and firing of the guns. With this an accepted standard of operation, is it not reasonable to expect increased automatic control in the textile field?

Hydraulics is another tool that will find increasing use wherever instant and positive responses are required at high frequency, as in accurately guiding the high speed operation of a pin tenter. The use of a hydraulic variable speed transmission is becoming more frequent, and gives wide ranges of continuous speed control in a very compact space. The possibility of transmitting power by a combination of fluid motors with a positive displacement pump deserves special mention, because it allows the elimination of certain troublesome line shafts. This can also be done electrically by a combination of selsyn transmitter with selsyn receiver.

Cooperation Between Mill and Machine Designer Needed

All of these intriguing possibilities for improved production and quality bring us naturally to the need of closest cooperation between mill operating men and machinery manufacturer if we are to realize their benefits in the shortest possible time. From the mill operating side alert management knows the results it is trying to achieve and the effect of different treatments. From the machinery manufacturers' side, alert organization has the knowledge of tools available to

accomplish requirements laid down by the mill. This is a perfect relationship in which knowledge on one side complements knowledge on the other, and out of this union can come better processing equipment and improved quality. Cooperation should in many cases include the chemical company. It is hardly fair to a new process to start with improper equipment, in a setting that foredooms it to failure or at best mediocre results. Of course it is necessary to use existing machines, but I submit to you the wisdom of consulting with the machinery company which knows the features of its particular machine. Let me give you one historic example where a development was held up for over 10 years by an improper inception. Not many people realize this, but the first continuous bleach system was installed many years ago. It was put in an out of the way position in the mill, with a crude, makeshift arrangement. No wonder that it did not immediately revolutionize the industry and was discarded.

There is one other question that should be mentioned in this connection, and here again I feel that I can speak for the general group of process engineers and equipment manufacturers. A machinery manufacturer will go to any length to protect and hold confidential any development work done in connection with a plant process. This indoctrination is so complete in our particular organization that we are reluctant even to mention firm names in connection with machine installations. I feel sure that this same principle and discretion exists in other reputable companies.

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Hydrodynamic Test—

(Concluded from Page P343)

this is so, then in the case of several fabrics where the resistance to certain kinetic energies is the same, the hydrodynamic results should vary directly as the results of the test on the remaining kinetic energy range. In other words, if several fabrics have the same results on the two low kinetic energy tests (hydrostatic and impact), then the hydrodynamic and Lowell tests should be in proportion to each other. If several fabrics have the same results on the two higher kinetic energy tests (impact and Lowell), then the hydrodynamic test should be in proportion to the hydrostatic test.

Table VIII is a test of the above reasoning. In series A we have three of the fabrics tested which gave identical results on the Lowell and impact tests but differed in the hydrostatic results; it will be noted that the hydrodynamic results follow along with the hydrostatic results. In series B we have two fabrics which are alike in the hydrostatic and impact but differ in the Lowell test; here the hydrodynamic results parallel the Lowell test results. Series C is two fabrics which have the same hydrodynamic results; if we examine the results of the other tests we find that there is little difference between the fabrics but that difference is contradictory. In other words, the Lowell test and hydrostatic test show the first fabric as slightly better than the second, while the impact test shows the second as slightly better than the first. Series D shows the same results for another pair of fabrics having the same hydrodynamic results. Here the hydrostatic and impact tests show the first fabric to be slightly better than the second, the Lowell test shows the second to be slightly better than the first. We believe, then, that the hydrodynamic test integrates and combines the results of several different test methods into one figure which gives the overall efficiency of the fabric as regards water resistance.

Conclusions

In the introduction, the authors presented a list of seven desirable features in a water resistance test. Let us see how the hydrodynamic test meets these requirements.

1. The hydrodynamic test has not yet been correlated directly with actual rain; it is hoped to do this in the near future. It does correlate well with other tests which have in turn been correlated with actual rain results, and integrates several of these tests into one result.

2. A solid non-absorbant backing is used in the hydrodynamic test.

3. The hydrodynamic test is sensitive to small differences in the fabric, even at high degrees of resistance. Note in Table II that a large number of fabrics listed as 60+ on the Lowell test and zero on the impact test are given definite ratings on the hydrodynamic test. Only one fabric went above the range of the instrument (114+) and this range could easily have been extended if necessary.

4. The hydrodynamic test increases the kinetic energy of the spray until failure results and hence gives the greatest intensity of rain for which the fabric is satisfactory.

5. The effect of double layers of fabric is in line with actual rain room results.

6. The end-point is simple, sharp, and does not require any weighing or any standard blotter.

7. The result is a single figure by which different fabrics may be compared.

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May 21st Meeting, WNE Section

A MEETING of the Western New England Section will be held on May 21st at the Waverly Inn, Cheshire, Connecticut. The meeting is scheduled for 8:15 and will be preceded by a dinner at 7:00. The speaker will be Fredrick T. Simon, Sidney Blumenthal & Company, and his subject will be "An Application of Spectrophotometry in a Textile Plant".

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Meeting, South Central Section

A MEETING of the South Central Section was held April 10, 1948, in Chattanooga, Tennessee, at the Patten Hotel. Dr. Raymond B. Seymour, Chairman, presided at the Technical Session and at the banquet.

There were seventy present at the technical session at 5:00 p.m. Norman F. Barnes gave a very interesting talk on the "ABC of Color and Spectrophotometry".

At the banquet there were 84 present. After the secretary and treasurer made reports, Albert Crumley reported on his trip to New York at which time he represented Jack Anderson as councilor. Jack Anderson gave a short report on the National Convention to be held in Augusta.

After W. S. McNab gave a report on the possibilities of having a summer outing in Knoxville, Tennessee, at the Whittle Springs Hotel, it was voted to have an outing there on June 4th and 5th.

Mr. Schlemmer, General Manager of the Peerless Woolen Mills, held the attention of everyone with his talk, "A Responsibility of the Technical Man to His Community and Country". After his speech, the meeting was adjourned.

Respectfully submitted,
H. P. Loveless, *Secretary*.

TRADE NOTES • NEW PRODUCTS

• Vice-President, UCC

The election of Dr. George O. Curme, Jr. as *Vice-President—Chemical Research* of Union Carbide and Carbon Corporation is announced by Fred H. Haggerson, President. Dr. Curme has been for many years a Vice-President and Director of Bakelite Corporation, and Carbide and Carbon Chemicals Corporation, both units of Union Carbide.

Dr. George O. Curme

Dr. Curme is a pioneer in the American organic chemical industry. He was the first to develop the chemistry of aliphatic compounds in the United States. His research work on acetylene at the Mellon Institute of Industrial Research, Pittsburgh, from 1914 to 1919, resulted in the formation in 1920, of Carbide and Carbon Chemicals Corporation. During subsequent years Dr. Curme has witnessed the commercial output of his research findings expand to an annual production of over 9 billion pounds. These products include synthetic ethyl alcohol, ethylene glycol, acetic anhydride, vinyl plastics, and some 200 other aliphatic chemicals.

Dr. Curme has been the recipient of many medals in recognition of his achievements in chemistry. He received the Chandler Medal from Columbia University in 1933, the Perkin Medal, awarded by the Society of the Chemical Industry in 1935; the Elliott Cresson Medal from Franklin Institute in 1936; the National Modern Pioneer Award from the National Association of Manufacturers in 1940; and the Willard Gibbs Medal from the American Chemical Society in 1944.

Dr. Curme is an active member of the American Chemical Society, the American Institute of Chemical Engineers, the American Association for the Advancement of Science, the Society of Chemical Industry, the Societe de Chimie Industrielle, and the Chemists' Club, New York.

He attended Northwestern University, took a year of graduate study at Harvard University, and a doctorate at the University of Chicago. He then went abroad to study with Fritz Haber, discoverer of the synthetic ammonia process at the Kaiser Wilhelm Institute. He also studied with Emil Fischer, a co-discoverer of the Fischer-Tropsch synthetic chemical process at the University of Berlin. At the outbreak of World War I, Dr. Curme returned to the U. S. to begin his work at Mellon Institute. He has since introduced many new concepts to American chemistry.

• Houghton Folder

E. F. Houghton & Co. of Philadelphia, has issued a new four page folder on lubricants for textile machines. The folder deals with the objectives of textile mill lubrication and contains photographs of typical applications of Houghton's textile lubricants.

The back cover is devoted to a new textile lubrication chart, offering recommendations as to the types of lubricants needed for various textile machines. Copies of the folder are available upon request to E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

• Spring Meeting, ASTM Committee D-13

A review of the actions and discussions which took place at the Spring Meeting of ASTM Committee D-13 on Textiles Materials in New York City March 17 to 19 inclusive indicates the activities which this technical committee has under way. The interest in the committee is evidenced by the registered attendance of 206 members and 53 guests, or a total of 259, the largest since the committee was organized in 1914. Meetings were held of some fifteen sub-committees.

The highlight of the meeting was a technical session on Thursday afternoon at which the following three papers were presented:

"The Importance of Time Factor in the Study of Textile Properties" by Prof. Edward R. Schwarz, Massachusetts Institute of Technology, Cambridge, Mass.

"The Stress Strain Curve as a Laboratory Tool in Textile Research" by Dr. Walter J. Hamburger, Fabric Research Laboratories, Boston, Mass.

"Some Applications of Stress Strain Measurements to the Determination of Fiber Properties" by Dr. Arnold M. Sookne, Harris Research Laboratories, Washington, D. C.

The Subcommittee on *Cotton and Its Products* acted on an important revision of the Specifications for Cotton Tapes for Electrical Purposes which will now cover woven tapes used in the electrical industry from thicknesses from 0.030 in. down to 0.005 in. inclusive.

The Subcommittee on *Man-Made Organic-Base Fibers* considered a new technique for determining wet strength. This procedure uses the strip rather than the grab method. A procedure for determining the "shift" of man-made fabrics is under consideration. A progress report describing the shift tester was presented at the meeting.

The Subcommittee on *Wool and Its Products* completed a revision of the Test Methods and Specifications for Woolen and Worsted Yarns. Progress reports from task groups were made on the following: (a) sampling of carpet wool, apparel wool, scoured wool for clean content, and raw wool for grade; (b) determination of moisture in scoured wool, top, etc.; (c) conversion factor for wool (top-soil-waste relationship). Work is also under way on studies of tests for fineness, shrinkage, and moisture.

The Subcommittee on *Asbestos and Its Textile Products* reported the completion of an extensive revision of the Standard Specifications and Methods of Test for Asbestos Yarns (D 299). Action was also taken on a Method of Determining Magnetic Rating of Asbestos Lap.

The Subcommittee on *Bast and Leaf Fibers* considered the data from a laboratory study of an optional alternative method of determining ethylene dichloride extractable matter. This new method which requires a much shorter time than the present referee method, will, when approved, be included in the Methods of Testing and Tolerances for Jute Rove and Plied Yarn for Electrical and Packing Purposes (D 681). This committee also has in preparation a series of methods of test for twine.

The Subcommittee on *Household and Garment Fabrics* will submit to letter-ballot a revision of the Tentative Specifications for Bleached Wide Cotton Sheeting (D 503). The present specifications cover six types of sheeting and are being

replaced by the following four types: percale (Type 200), carded percale (Type 180), heavy weight muslin (Type 140), and medium weight muslin (Type 128).

The Subcommittee on *Glass Fibers* considered an interlaboratory test for comparing breaking strength of raveled strip specimens having the end sections protected with pressure sensitive tape, with others protected with methacrylate solution. A study of abrasion of glass textiles is under way and methods for determining sizing are to be prepared. The need for test methods for decorative fabrics was also discussed.

Another subcommittee that has been very active is that dealing with *Wool Felt.* At its meeting a paper by R. R. Stevens was presented on "Laboratory Methods for Evaluating the Felting Power of Wools." This committee has under consideration a number of additional tests for wool felt which include procedures for hardness, stiffness, amount of sizing mildew and fungi resistance, thickness of soft felts; also specifications for roll and sheet felt. Consideration is being given to a method of test for determining hydrogen ion concentration (pH value) of felt.

The Subcommittee on *Pile Fabrics* considered the interlaboratory testing program for studying flame test procedures and for determining resistance to insect damage. Methods of testing Kraft yarn were also considered and a review made of methods of evaluating resistance of pile fabrics to spotting.

The newly organized Subcommittee on *Hosiery* held its second meeting at which replies to a questionnaire on test methods were reviewed. Plans were made for an intercomparison study by some ten laboratories of the du Pont snag tester. There was considerable discussion of the need for service tests of hosiery. A report on this subject, containing a number of suggested methods was discussed. Work is to be undertaken on the development of a stretch test. Replies to the questionnaire indicated that many laboratories were using three types of machines: namely, the Scott pendulum, du Pont tester, and Scott incline plane apparatus. It was decided to draft methods based on these three machines and then to run an interlaboratory comparison on the three methods.

The new Subcommittee on *Bonded Fabrics* reviewed drafts of proposed methods which cover test for weight, tensile strength, water absorbency and related properties of non-woven fabrics.

In the Subcommittee on *Test Methods* task groups have been established to develop test procedures on the following subjects: bulk fibers, elastic fabrics, stress-strain curves, thermal transmission, jaws and clamps, calibration of incline plane testers, water resistance, viscosity, methods of quantitative analysis, and procedures for determining copper, manganese, and nickel in textiles. An alternate procedure was presented for inclusion in the Test for Apparent Fluidity of Dispersions of Cellulose Fibers in Cuprammonium Hydroxide (D 539). Revisions under consideration in the Test for Resistance of Textile Materials to Micro-organisms (D 684) include the standardization of soils to be used; also a standard soil fabric, pH control, steam sterilization, and other related features. One important decision was to reactivate the task group on fire tests. The meeting of this subcommittee was featured by a report on wear testing. The session was concluded by the presentation of a very interesting and final report of the task group studying the Wyzenbeek precision wear test meter prepared by S. J. Tanenhaus and Gerald Winston of the Textile Research Laboratories, Philadelphia Quartermaster Depot. This report, presented by Mr. Winston, concludes this series of interlaboratory studies. The report, presenting considerable data and some very interesting conclusions, may be published in an early issue of the ASTM *Bulletin.*

The Subcommittee on *Definitions* presented a revision of the term "rayon" which will restrict it to regenerated cellulose type fibers. Action was also taken recommending the use of the term "esteron" as a generic term for cellulose ester fabrics.

The Subcommittee on *Atmospheric Conditions* considered the results of a questionnaire on the subject of standard atmospheric testing conditions. A relative humidity of 65 per cent at a temperature of 77° F. has been recognized and used for some years in testing textile fibers and textile goods. A number of other groups in ASTM had, however adopted a 50 per cent relative humidity. Consideration had been given to the proposal advanced by an FSB Technical Committee recommending the establishment of 73.4° F. and 50 per cent relative humidity as the standard atmospheric conditions. This proposal was also being favorably considered by the Technical Committee on Conditioning and Weathering, of ASTM Committee E-1 on Methods of Testing. The results of this D-13 questionnaire, however, indicated that the textile committee favors very definitely a relative humidity of 65 per cent. However, it was decided to submit to letter-ballot vote a change in the standard temperature from 77° F. to 73.4° F.

• List of Standards Available

An up-to-date list of all national standards approved by the American Standards Association has just been published and is now available free of charge. The American Standards listed have been developed through the procedure of the American Standards Association by the national groups in each of the fields covered, ranging from civil engineering and construction, mechanical engineering, electrical engineering, to chemicals and textiles. The "all party-at-interest" procedure of the Association has assured their acceptance by a consensus of all groups concerned and has given the standards included in this new list the standing of "American Standards."

The new price list makes available a complete set of all American Standards at $225.00 and a complete set of all American Safety Standards at $35.00. Quantity discounts range from 20 percent to 45 percent for quantities up to 1,000 copies.

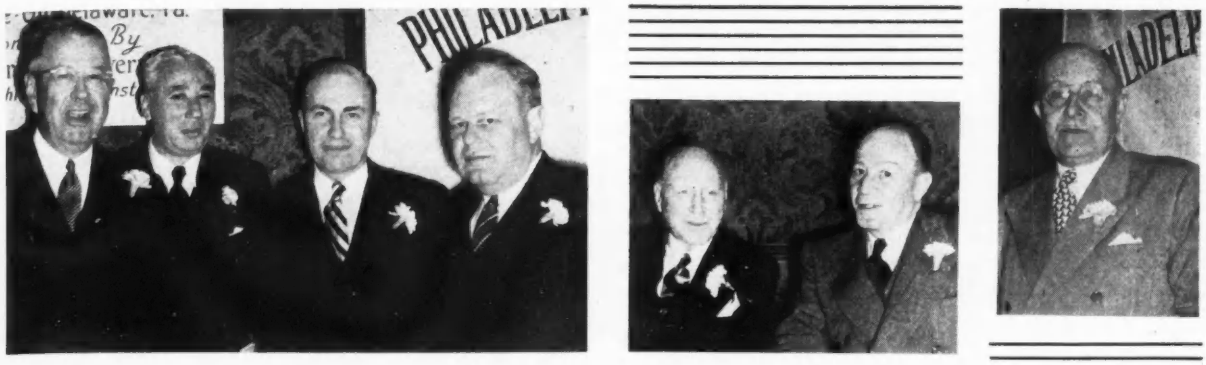
Copies of the list can be obtained from the American Standards Association, 70 East 45th Street, New York 17, N. Y.

• Meeting, New York Alumni, PTI

More than 150 members and guests attended the annual spring dinner of the Philadelphia Textile Institute Alumni Club of New Yorka held on April 22nd at the Builders Club, 2 Park Avenue, New York.

The principal speaker was Robert L. Huffines, Jr., President, Burlington Mills Corporation of New York and a member of the class of 1926. The title of his address was "America's Biggest Industry Needs America's Best Brains". Mr. Huffines' remarks were closely concerned with training men for the textile industry, pointing out that it is the largest employer of men and women in America, last year there being somewhat more than 2,000,000 persons working at the production of textiles and producing goods which sold for over 12 billion dollars. He pointed out that it was not so many years ago that the young men of America were under the impression that people in the textile industry either had "been born into it or had been dropped on their heads. The time has come when we must make certain that our manpower is not dependent upon the happenstance of birth or the misadventure of the uncontrolled force of gravity".

He indicated that the 500 men to be graduated from the 9 textile schools this year is a pretty inadequate number when spread over a working force of 2,000,000. To provide a sufficient number of trained men it is necessary for industry to cooperate with the established schools and help to educate greater numbers and to embark on a vigorous program of recruiting and training within the industry.



PRESENT AT PTI ALUMNI MEETING: left to right—Gerome Leonard, Gerome Leonard Co.; Bertran A. Stroock, retired; Leon P. Brick, President, New York Alumni, PTI and Vice-President, Onyx Oil & Chemical Co.; Robert L. Huffines, principal speaker at the meeting, President, Burlington Mills Corp. of N. Y.; Lewis A. Hird, Treasurer, Samuel Hird & Sons, Inc.; Kenneth Collins, Vice-President in charge of Advertising and Public Relations, Burlington Mills Corp. of N. Y.; and Richard Coxe, Dean of PTI.

Photos by John E. Trezise

Because of new developments it is necessary for the management of textile concerns to employ men capable of directing many specialized phases, Mr. Huffines stated. "Spinning, throwing, weaving and finishing are now a part of a continuing business. Today, the textile man who enters any single section of our industry cannot look for success unless he has the ambition, the opportunity and the capacity to explore and absorb much of what is being done in the other sections of the textile world."

"Competition in the future will demand larger numbers of capable men", Mr. Huffines said, "trained in chemistry and skilled in the handling of production problems. We will need men whose specific knowledge of textiles and general knowledge of management practices will give them the understanding necessary to coordinate production, sales and finance in such a manner as to direct sound and healthy business institutions."

"I feel that if industry in general would accept the responsibility for an adequate training program," Mr. Huffines concluded, "our schools could devote themselves to providing the broadest possible education. This is not a wish prompted by any selfish interest in the progress of business. Neither is it predicated on any desire to develop men for the sheer pleasure of watching them grow. Our industry has a grave national responsibility, both in peace and in war, and it seems to me that we who are active in it today must take immediate steps to attract to and develop within the industry more men with vision, courage, and a broad, sound knowledge of textiles who will be capable of furnishing leadership of tomorrow."

Leon P. Brick, '25, Onyx Oil & Chemical Co., Inc., President of the New York alumni group, presided at the meeting. Other officers of the organization are: Edgar L. Schlesinger, '25, Cohn-Hall-Marx Co., *1st Vice President;* Arthur Ernst, '26, Textron, Inc., *2nd Vice President;* Edwin Wilkinson, '27, National Association of Wool Manufacturers, *Corresponding Secretary;* Edward S. Lukens, '40, Cannon Mills, Inc., *Recording Secretary;* Max Schuster, '28, Cantor, Greenspan Co., Inc., *Treasurer.* Directors are: J. Elmer Hahn, '14, Fieldcrest Mills, Lewis A. Hird, '10, Samuel Hird & Sons, H. B. Schaeffer, '21, Stonecutter Mills Corp., Herbert H. Schell, '15, Sidney Blumenthal & Co., Frederick H. Schloss, '16, Darlington Fabrics Corp., and J. Kenneth Taylor, '16, J. K. Taylor & Co.

• "Elvanol" Polyvinyl Alcohol

The polyvinyl alcohols, solid alcohols in powder form, are a series of versatile resins of proved usefulness in a great variety of industrial applications. The Du Pont Company describes the physical and chemical properties, commercial grades, uses and applications of these resins in a new booklet, "Elvanol" Polyvinyl Alcohols.

By varying conditions of manufacture a whole series of polyvinyl alcohols, each with markedly different physical properties, can be made. From the large number of possible compounds Du Pont has selected ten grades for commercial manufacture. The booklet gives a summary of major industrial uses under the general headings—Adhesives and Binders, Textile Sizing, Paper Sizing and Coating, Molded Products and Film, Stencil Screens, Ceramics, Temporary Protective Coatings, Emulsifying and Thickening Agents.

• Lanaset Treated Blanket

A standard type hospital blanket which had been treated with American Cyanamid's Lanaset Resin was put through the customary rigorous washing with negligible shrinkage, according to a letter received by American Cyanamid Company from Robert B. Lawson, laundry manager of the Memorial Hospital.

The blanket taken from stock was treated with Lanaset Resin at Cyanamid's textile resin laboratory at Bound Brook and identified by a special marking before being put into regular use at the hospital.

It is stated that after six standard washings, similar untreated blankets showed a shrinkage of as high as 42%, whereas the Lanaset Resin treated blanket had lost only 2" in width and 1¼" in length and showed no signs of felting.

The washing formula used at Memorial Hospital was as follows:

1. Suds: 20" water level; temperature 98° F; time (actual running time) 2 minutes.
2. Rinse: 20" water level; temperature 98° F; running time 1 minute.
3. Repeat No. 2
4. 20" water level; sour; run 1 minute.

The supplies used were: Calgon, Ivory Soap and Erustocide.

The wash wheel was stopped between drains and refills.

After repeated laundering of this sort, it is ordinarily necessary to sew two blankets together to be of any further service. It is stated that the treated blanket was practically in new condition.

• New Laboratory Instruments

Henry A. Gardner Laboratory, Inc., 4723 Elm Street, Bethesda 14, Maryland, announces the publication of bulletins describing the following instruments:

Automatic Continuous Recorders for Gloss, Reflectance, Etc.—to obtain continuous records during production from paper, fabrics, plastics, films and other materials produced by continuous processes. A 75° gloss exposure head has been com-

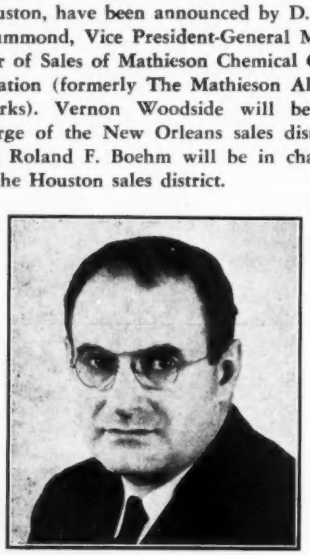
bined with a specially modified recorder to make a continuous gloss recorder and a method for keeping it continuously in calibration has been devised. The technique may be applied with little variation to measurements of reflectance, brightness, opacity and at least some of the factors of color.

Hunter Photoelectric Colorimeter and Color-Difference Meter—a new instrument for direct measurements of color and small differences in fabrics, paints, plastics, ceramics, etc. The instrument is a photoelectric tristimulus colorimeter measuring color on three scales closely resembling the L, *a* and *b* scales devised by Scofield. Photocell windows and the measuring circuits have been selected so that the three values of color are read directly from 10-turn potentiometer rheostats. These three rheostats may be set to the values of some standard color and a specimen of somewhat similar color then placed in exposure position. As a selector switch is turned to each of three positions, defection of the current-detecting galvanometer shows the magnitude on that scale of the color difference between the specimen and the standard.

Copies of the bulletins are available upon request and other literature will be available shortly.

• Southern Sales Area, Mathieson

A new Southern sales area, with headquarters at New Orleans, and new district sales managers at New Orleans and Houston, have been announced by D. W. Drummond, Vice President-General Manager of Sales of Mathieson Chemical Corporation (formerly The Mathieson Alkali Works). Vernon Woodside will be in charge of the New Orleans sales district and Roland F. Boehm will be in charge of the Houston sales district.



Vernon Woodside

Mr. Woodside joined the Mathieson organization in 1936 as a member of the Sales Development and Technical Service

Roland F. Boehm

Department, and, until his present appointment, specialized in technical service to the pulp and paper industry. As District Sales Manager for the New Orleans territory, he will make his headquarters in a branch office being established in the Queen and Crescent Building, 344 Camp Street, New Orleans, La.

Mr. Boehm succeeds W. S. Hammond, recently deceased, as District Sales Manager of the Houston Sales District. During World War II, he served with the War Production Board as Assistant Chief of the Nitrogen Unit, Chemical Division, Washington, D. C. He has been with Mathieson since January, 1946. His headquarters are in the Second National Bank Building, Houston, Texas.

• Annual Meeting, ASTM

At its Fifty-first Annual Meeting in Detroit the week of June 21, the American Society for Testing Materials has arranged 18 technical sessions extending from Monday through Friday. Throughout this week, in fact beginning two days before, technical committee meetings will be held with an anticipated number of over 300. Frequently 15 to 20 such meetings will be running simultaneously.

Throughout the week of the meeting and opening at noon, Monday, June 21, there will be held the Society's Eighth Exhibit of Testing Apparatus and Related Equipment, and an interesting Photographic Exhibit will also be in progress.

The Exhibits are at the Book-Cadillac, which is the main registration headquarters but there are auxiliary headquarters at the Statler and Detroit-Leland, where committee meetings and some sessions will be held.

An interesting feature of the meeting will be an unusual Marburg Lecture on Thursday, June 24 when Dr. P. C. Aebersold, Chief, Isotopes Div., Atomic Energy Commission, Oak Ridge, Tenn., will discuss "Isotopes and Their Application in the Field of Industrial Materials".

Anyone interested in the field of materials or instruments or in the work ASTM does in specifications and tests, is cordially invited to attend the technical sessions and exhibits.

• Annual "Cruise", PTI Alumni

On Friday, June 4th the Alumni Association of the Philadelphia Textile Institute will hold its Forty-seventh Annual "Cruise" at the Manufacturers' Golf and Country Club, Oreland, Pennsylvania.

Activities will get under way in the morning with an 11:00 A.M. Annual Business Meeting of the Association. The annual Golf Tournament will be held under the leadership of Robert H. Crompton, Jr., '34, and there will also be baseball, swimming and tennis for the more energetic attendees.

While no formal luncheon is planned, restaurant facilities at the club will be available at noon. The Cruise Dinner will begin at 7:00 P.M. and General Chairman, Edwin G. Michie, '35, announced that there will be no formal speeches. Prizes for golf and other activities will be given at this banquet.

All the Alumni of the Philadelphia Textile Institute and their guests are invited by the Association to attend and reservations should be sent to Frank L. Giese, 320 South Broad Street, Philadelphia 2, Penna. The tickets are $6.00 per person.

• 100th Anniversary, Linder & Company

To commemorate their 100th anniversary, the firm of Linder & Company, Inc., textile and industrial chemicals, 296 North Beacon Street, Brighton Station, Boston, Mass. have issued a brochure covering some of the highlights of the company's history.

The cover of the brochure is a photolithographic reproduction of the private ledger used to keep the records of the firm's early business; a line drawing of the India Wharf in 1860 appears on the title page and was presented to the firm by the artist, J. M. Barnard, II; and a map which shows the early locations of the firm's offices was once among the possessions of Henry Wadsworth Longfellow.

The firm was started as a partnership of George Linder, great grandfather of the current president, John F. Linder, Jr., and George A. Meyer. The firm of Linder & Meyer was dissolved in July, 1927, and the present company, Linder & Company, Inc., was organized. In May, 1928, the business of the late Robert W. Neff, man-

ufacturer and developer of textile sizes and finishing compounds, was acquired. In addition to products of their own manufacture, Linder & Company also represent some of the leading chemical manufacturers in Metropolitan Boston and the northern New England area.

• Warwick Moves Offices

The Warwick Chemical Company, division Sun Chemical Corporation, have announced the removal of their offices from 580 Fifth Avenue, New York City, to the Sun Building located at 10-10 44th Avenue, Long Island City, New York. The telephone number is Stillwell 6-1100.

The increased scope of the Warwick operation necessitated these larger quarters. The adjacent facilities of the laboratories will enable Warwick to enlarge their extensive technical consumer services.

• Research Building, Pabst

Dr. Alexander Frieden, Director of Research of the Pabst Brewing Company, has announced that research personnel is now moving into the newly completed Research Building, which has been under construction during the past eighteen months. It is located on the corner of 11th and McKinley, in Milwaukee, within the confines of "Pabst City". The entire building covers about 30,000 sq. ft. Approximately 5,500 sq. ft. of the first floor is taken up by the pilot plant. The remainder of the first floor, with offices and the Engineering Laboratory. The second and third floors are devoted to laboratories and to service units for the laboratories.

Research activities have been gradually increased and the research personnel expanded during the past year. This trend will now continue at an accelerated pace.

• Hercules Powder Tours

Hercules Powder Company has inaugurated a series of tours of several of its plants and laboratories for student chemists, chemical engineers and their professors. The tours include the Hercules Experiment Station, the company's central research laboratories near Wilmington, Del.; the Hopewell, Va., cellulose products and chemical cotton plants; and the naval stores plant at Brunswick, Ga.

Dr. Emil Ott, Hercules director of research, and other members of the research staff, arranged the visits as a means of promoting better understanding between university and industrial research men. The trips provide an opportunity for the university groups to see how research is integrated with chemical production.

As a special feature of the trips, transportation from the universities to Hercules' Experiment Station and plants is provided by one of the company's Lockheed Lodestar planes.

So far, students from two universities—Massachusetts Institute of Technology, April 4-8, and the University of Illinois, March 16-20—have been flown in. More trips for other universities are planned for the fall.

Students are selected by faculty and chemical engineering department heads on the basis of their interests and ability to profit from the trip.

• NETF Campaign

New England Textile Foundation, 68 South Main St., Providence, R. I. announces that on April 19th they passed the $200,000.00 mark in their Second Annual Campaign to raise $250,000 for the benefit of the four textile schools in New England. 236 gifts and pledges have been received for a total of $207,420.00, leaving $42,580.00 still to be raised. It is stated that, since one gift received on April 19th was $15,000.00 and another $3,500.00, prospects for raising the additional money needed are fairly bright. The campaign will continue until June 30th.

• du Pont Expansion of Research Facilities

A $30,000,000 expansion of research facilities at the Du Pont Company's Experimental Station in Wilmington has been approved by the Executive and Finance Committees and submitted for ratification to the Board of Directors, the company announced recently.

This is the biggest single laboratory project the company has ever undertaken. It will make the Wilmington Experimental Station, birthplace of nylon, neoprene, and other products, one of the largest research establishments in the world.

Some of the company's research organizations now located elsewhere will transfer to the new facilities to be provided here. The ones already at the station are laboratories of the Chemical, Engineering, Grasselli and Ammonia Departments, the nylon laboratory and the Haskell Toxicological Laboratory. They will be joined by the Rayon Pioneering Laboratory, by research personnel of the Plastics and Pigments Departments and by additional Grasselli Department research activities. The number of chemists and other technologists at the station will be almost doubled when construction is completed.

It is stated that this major addition to scientific facilities will be an important factor in a program to increase Du Pont's activities in fundamental, long-range research as well as research directed toward the development of new chemical products and processes.

• General Aniline Conference

The Fourth Annual Research and Development Conference held by General Aniline & Film Corporation opened at Skytop, Pa., on April 25th with a dinner for the delegates at Skytop Lodge.

165 men and women, comprising one-quarter of the General Aniline technical staff, heard Richard C. Patterson, Jr., former U. S. Ambassador to Yugoslavia, the principal speaker, describe his experiences as a war-time Ambassador in a Communist country. Jack Frye, President of the Company, also spoke and Dr. Cary R. Wagner, Vice President in charge of Research and Development, presided.

Technical sessions given over to the reading and discussion of scientific papers continued to adjournment of the Conference on Wednesday. Delegates were present from the Ansco film and camera division, the dyestuffs division and the Ozalid division, as well as the Central Research Laboratory.

• Bulletin on Compound G-4

The use of Compound G-4 for mildewproofing and rotproofing is described in Technical Bulletin 48-3, just issued by Sindar Corporation, 330 West 42nd Street, New York, N. Y. Compound G-4 is a chlorinated phenol which has the structural formula, bis (5-chloro-2-hydroxyphenyl) methane. According to the bulletin, which is available upon request, Compound G-4 was developed as an antiseptic, germicide and fungicide for use by the pharmaceutical and disinfectant industries and was later applied to mildewproofing textiles and leather goods.

The bulletin covers chemical and physical properties, toxicity, fungicidal activity, methods of application, formulas for consumer use, antiseptic finishes and methods for analysis. A bibliography is also included.

• General Release

General Dyestuff Corp., 435 Hudson Street, New York 14, N. Y., announces release of a new circular describing the following product:

Diazo Brilliant Blue BBLA-CF—a new domestically manufactured homogeneous diazo color which, when applied to cotton, rayon or other vegetable fibers and developed with Developer AMS or with beta naphtol, produces unusually bright greenish blue shades claimed to possess better wash fastness than is obtainable with other diazo blues. It is stated that the light fastness is fairly good on cotton and very good on rayon and the wash fastness is fairly good to good on both cotton and rayon. Aftertreatment with resin finishes for anticrease effects does not affect the light fastness. It is suitable for package dyeing. At the boil it exhausts rapidly but levels very well and when applied at lower temperatures the affinity also is good. Acetate rayon effects are left practically clean. Animal fiber and nylon are stained. It is sufficiently free from copper and manganese to be suitable for material to be rubberized. It is a non-dusting form. Dyeings are dischargeable to a white. Circular G-521.

• Onyx Data Sheets

Onyx Oil & Chemical Company, Jersey City 2, N. J., announces release of Technical Data Sheets describing the following products:

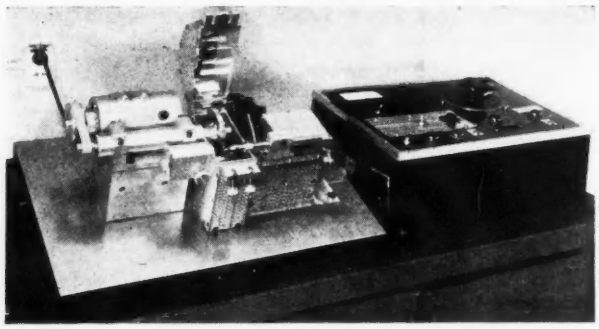
Xyno Resin S 69—a water-thin dispersion of a thermoplastic synthetic resin of fine particle size which is applicable to a wide range of fabrics and is said to provide a unique dry, "springy" hand. It may be used for stiffening, sizing and impregnating cotton, rayon, and nylon fabfabrics, for imparting a dry, springy hand to nylon and rayon nettings and for slipproofing. It is said to be an especially effective finish for nylon fabrics. Sheet No. 18-T.

Xyno Resin 362—a viscous dispersion of a thermoplastic synthetic resin of relatively coarse particle size. It gives a very stiff hand and is employed on cotton, rayon, acetate and nylon constructions. It may be used for stiffening, sizing and impregnating cotton, rayon, acetate and nylon, for stiffening ninons, organdies and marquisettes and for coating fabrics when used with a plasticizer. Sheet No. 19-T.

The data sheets also give information on the advantages of the products, application, chemical and physical characteristics, and shipping containers.

• Ultramicrotone

Custom Scientific Instruments, Inc., P. O. Box 170, Arlington, New Jersey, announces the Ultramicrotone, an instrument which can be used for the preparation of cross sections of all types of materials for light or electron microscopical examination. The instrument is based on research by the Interchemical Corp., New York.



The Ultramicrotone

It is stated that a range of cross sections from 16 microns to 0.1 micron can be obtained and it can also be used, with a few simple changes, as an ultracentrifuge, for the concentration of colloidal materials.

Features claimed for this instrument include the following: small space requirements, quick and easy installation, durable, only two major units, foolproof operation, direct speed reading, cutting blades changed with ease, no balancing of disc needed, complete safety features included.

Literature is available upon request.

• Mutual Chemical Plant

Mutual Chemical Company of America, according to a statement issued by its president, George Bennington, has completed plans for the construction of a new bichromate plant on property adjoining the company's present plant in Baltimore. The new facilities are scheduled for completion by the end of 1949 and will include additional capacity which, together with the company's existing facilities, should be sufficient to satisfy all likely demands and also provide improved working conditions and more efficient operations.

• Miniature Fluorescent Magnifier

A fluorescent fixture with an integral magnifier has been added to the line of Stocker & Yale, 48 Birch Street, Marblehead, Mass. Detailed inspection or comparison of fibers, weaves, and colors is said to be easy and accurate with this compact combination of cool, glare free light and optically correct magnification. Intense illumination of 350 foot candles floodlights the object from widely divergent angles, thus revealing all surfaces. Both eyes observe the object in fine detail through 2 power lens mounted in the reflector between twin 5 inch fluorescent lamps. Since the point of observation is directly behind the light source, internal surfaces of holes and cavities can be seen with ease. It is stated that lamp surface temperature of only 115° F. allows close work with complete comfort.

• Bjorksten Announces Patent Department

Dr. Johan Bjorksten, President of the Bjorksten Research Laboratories, 185 North Wabash Ave., Chicago, has announced the addition of a patent department to his organization.

The department has been established for service to clients, for collaboration with corporate patent departments, for counsel in chemical cases and for handling of chemical patent problems and negotiations.

The patent department will be headed directly by Dr. Bjorksten who is also registered to practice before the Patent Office. Mr. S. Jackson, L.L.B. has joined the department and Mr. Foster York, well-known Chicago chemist and patent lawyer, has been retained as counsel.

• Textile Instrument Course

Thirty-four textile instrument engineers from various mills throughout the country completed during February the third intensive course in textile industrial instrumentation which has been conducted since the war by the Brown Instrument division of Minneapolis-Honeywell Regulator Company.

The course, held at the Brown Instrument School, Philadelphia, included instruction in the operation and maintenance of electronic and other automatic measuring and controlling devices which are being increasingly made a part of textile manufacturing and processing modernization. The course was made available to instrument engineers of Brown customer organizations.

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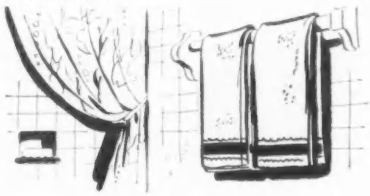
New "Fast Yellow Paste" Has Best Over-All Fastness Properties of Any Vat Yellow Available

Calcosol* Fast Yellow Paste, a new vat dye of the anthraquinone class, possesses the best over-all fastness properties of any vat yellow available at present. It produces a clear, bright, true yellow which will stand a minimum of forty hours' Fadeometer exposure even in very pale shades.

Possessing excellent working properties, Calcosol Fast Yellow Paste is especially recommended for dyeing rayon or cotton piece goods, yarn or raw stock in the usual dyeing equipment. It excels all other vat yellows in its fastness to light, chlorine, towel bleach and washing—hence it is excellent for towels, draperies, sheets and other applications requiring good fastness to light and laundering.

In application, Calcosol Fast Yellow Paste is not sensitive to reasonable variations in reduction and dyeing conditions.



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Through the years royal blues have always been very popular and undoubtedly will continue so. Such a shade suggests richness, clarity and depth at the same time.

Calcoloid* Blue BLD Double Powder or the corresponding paste type is ideal for the base dye for such shades on cotton and viscose. This is an anthraquinone vat dye, exhibiting excellent fastness to light, washing, chlorine and various other everyday requirements.

Calcoloid Blue BLD Double Powder and Calcoloid Blue BLD Double Paste are suitable for application on cotton rawstock, yarn or piece goods by either the pigment or reduced methods in practically all existing types of cotton dyeing equipment.

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Calcotone* pigment pastes offer great versatility in a wide range of applications. Seldom is a group of colorants capable of such an extensive range of uses.

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4. Padding in conjunction with a resin finish to eliminate a preliminary dyeing operation.
5. Padding on various cellulosic materials with suitable binders for a variety of end uses.
6. Very desirable sighting colors for wool, rayon, cotton or other fibers.
7. Coloring of paper in the beater.

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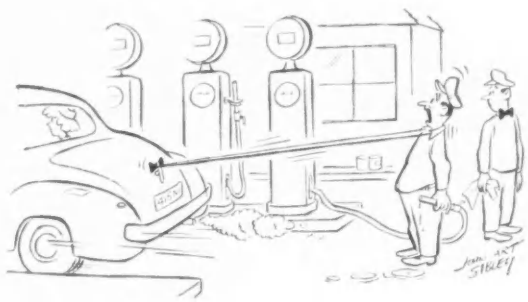
FOR THE TEXTILE BOOKSHELF

Part I—Selection of Dyes for Continuous Pigment Pad Dyeing Processes. Part II—Laboratory Apparatus for Studying Continuous Dyeing. (Calco Technical Bulletin No. 793) — Contains important data concerning the properties of vat dyes which will be helpful where continuous dyeing methods have been adopted. Part II—A laboratory machine is described which can be used not only for matching shades but also for exploring variations in dyeing procedures.

Studies of Rayon Dyeing: Applications of the Dyeometer. (Calco Technical Bulletin No. 795) — Describes the application of the Dyeometer to quantitative studies of some of the dyeing conditions in the dyeing of rayon, and in making a comparison of the dyeing properties of various rayons.



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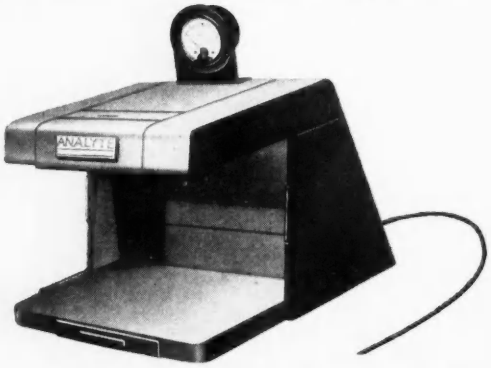

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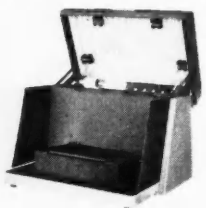
FREE TRIAL OFFER — We will gladly install an Analyte North Light Comparator for you to use during a generous trial period, without cost or obligation to you. Write today for further information and illustrated literature.



Top tilts back for access to incandescent bulb and grid.

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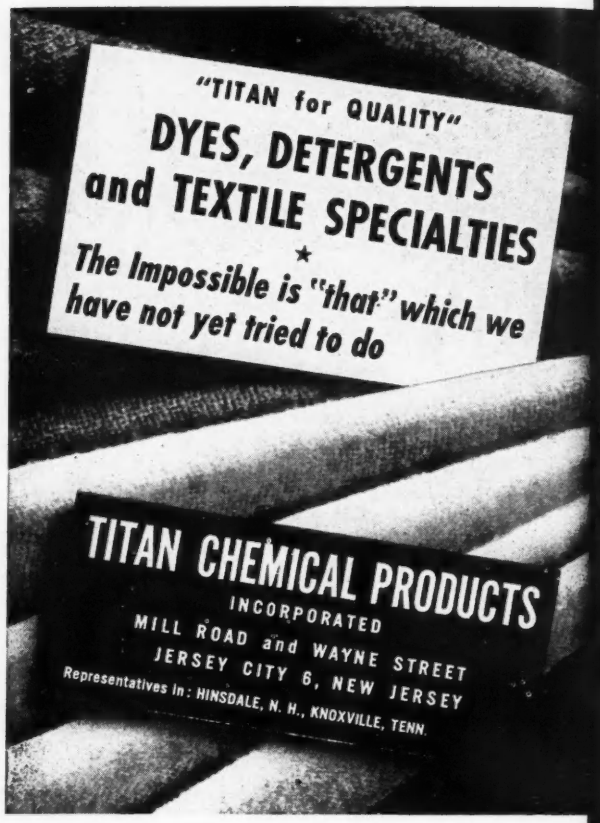
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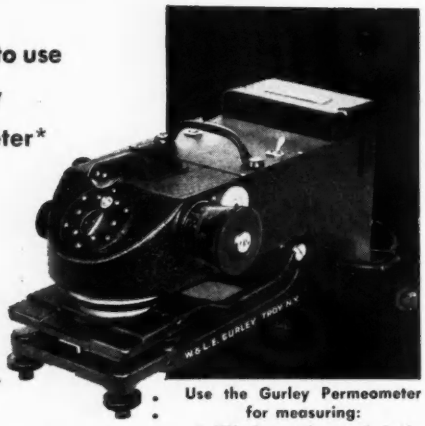
Ten ways to use the Gurley Permeometer*



Here's the versatile instrument for quickly and accurately measuring air permeability of fabrics which permit passage of from 1 to 400 cubic feet of air per square foot area at a pressure drop of 0.5" of water. Write for Bulletin No. 1600. W. & L. E. Gurley, 512 Fulton, Troy, N. Y.

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4. *Water-resistant* properties.
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6. *Construction* of cloth.
7. *Penetration* into cloth of various coatings.
8. *Retention of fillers, starch and sizing* in cloth after laundering or cleaning.
9. *Compactness, nap* or *fiber arrangement* in cloth after fulling, washing, sizing or other treatments.
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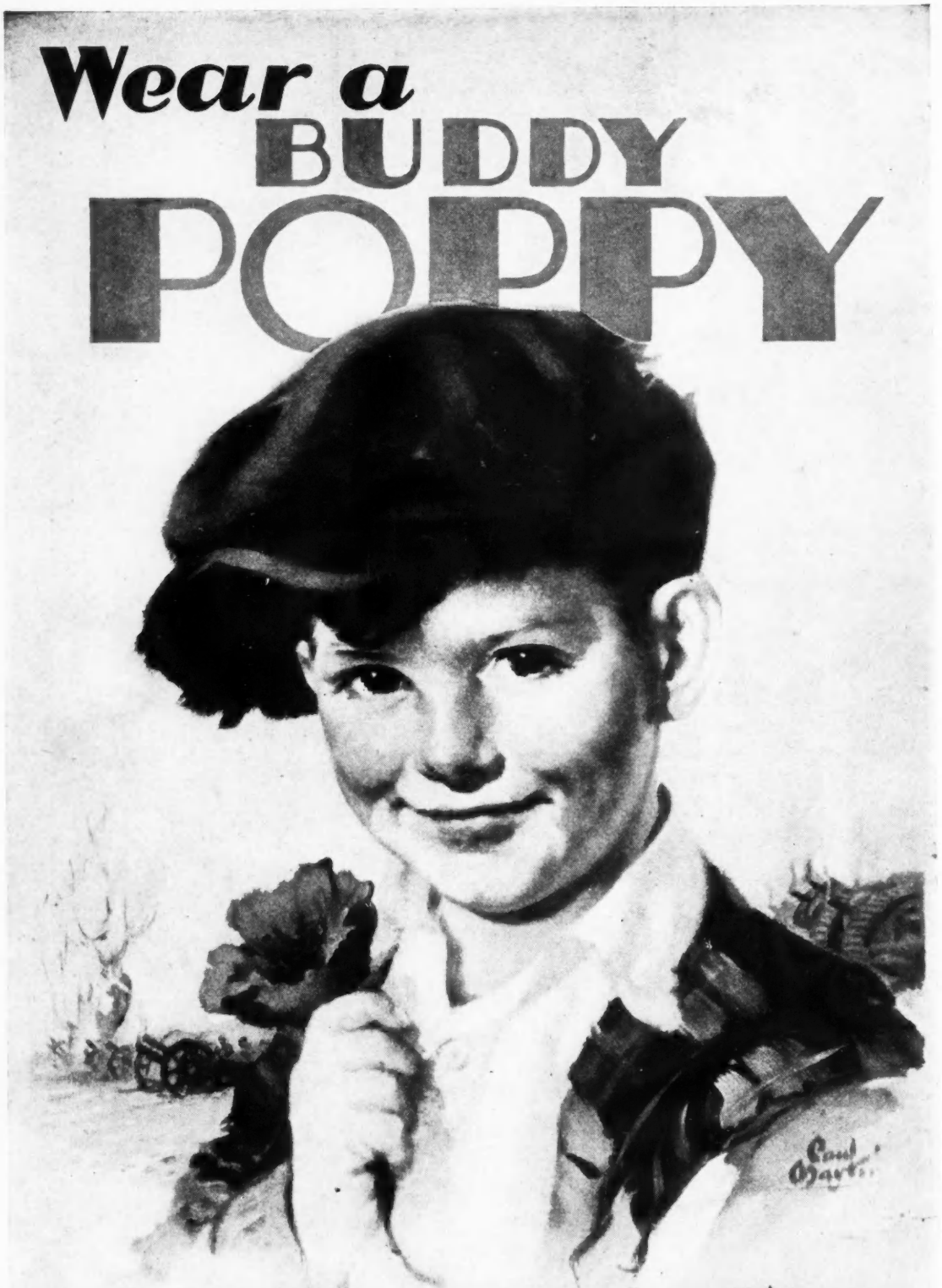
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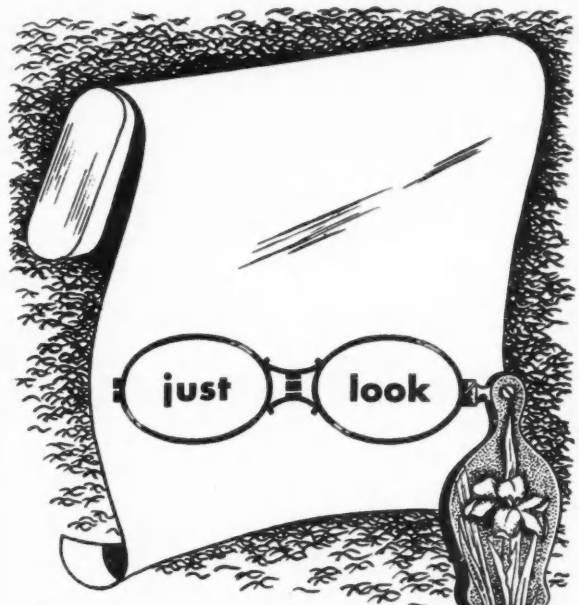

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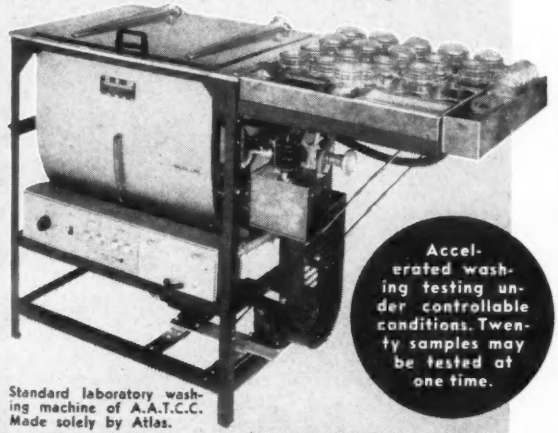

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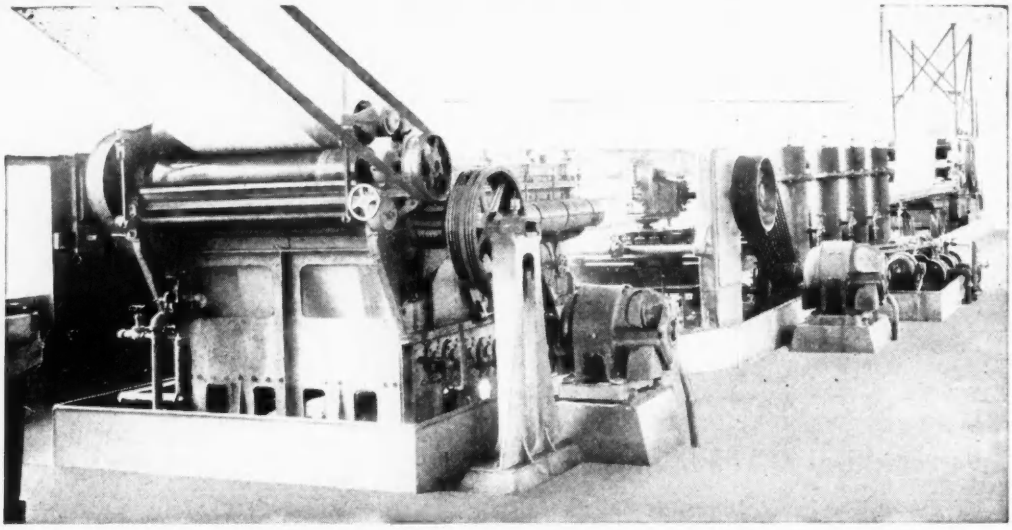

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